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The OIL AND GAS JOURNAL

published weekly by the

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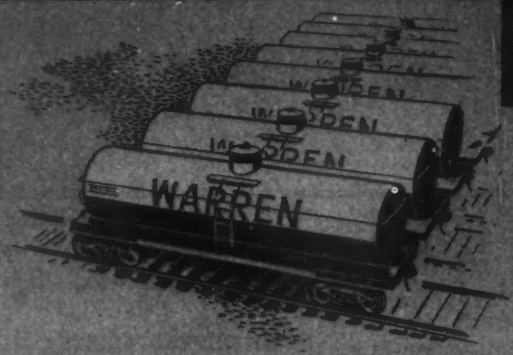

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THE OIL AND GAS JOURNAL

Young Men

CERTAIN oil associations which have broad industrial responsibilities have given special recognition to young men at their recent meetings and they will have positions of responsibility in the work of these organizations during the coming year. The presence and contributions of young men at the sessions of the various technical groups have been outstanding in recent months. The new reader lists of this publication reflect the fact that thousands have returned from the services, joining other hundreds who have become a part of the oil industry for the first time.

This is at it should be. The oil business is and always has been a young man's industry. Competent observers have said that in no other American enterprise since the turn of this century have there been greater opportunities than in the many-headed petroleum activities.

Looking forward this industry holds more for young men than ever before. We know now that the postwar era, petroleumwise, is to be one of steady expansion. During the emergency the oil business expanded rapidly, with older men taking on additional duties. Inevitably this situation has created a shortage in youthful manpower at a time when it is most needed.

The new laboratories announced this year which will give this industry leadership in research and development must be largely manned with specially trained young men. Everywhere there are new frontiers in exploration, production, manufacturing and transportation which await youth for further expansion. Growth in oil operations outside this country is dependent on youthful initiative, enthusiasm, and strength.

But along with opportunities come responsibilities, and veterans in this business of oil had that fact in mind in urging that young men be trained so that they can later effectually represent the entire industry or important segments thereof whenever the necessity arises.

Industrial advancement is not entirely a matter of techniques. There are qualities which for want of a better word we term character, including a sense of responsibility to others. These attributes are often somewhat intangible, but from them come a well-balanced economy and without which skills avail nothing.

This industry has been fortunate in its leadership of the past. A still greater trust and obligation await those who must be ready to direct it in the confusing times ahead. So as an old year nears its close we salute those who in 1947 and the years to come will not only be in charge of operating facilities but must be on the front lines in those matters having to do with industrial and public relations.

Committee Recommends Big-Inch Sale Without Restrictions on Use

WASHINGTON.—The big-inch pipe lines should be sold promptly to the highest and best bidder, preferably for cash, with the bidder free to use the lines for oil, gas, or both as he chooses, it is concluded by the House committee investigating surplus property in an interim report filed Monday.

The committee declined to make recommendations to War Assets Administration but expressed its conclusions following several weeks of hearings on the big-inch system. These were that the lines are readily salable at a good price and should be disposed of promptly to avoid maintenance and depreciation costs, that the bids should have as few strings tied to them as possible, that use for natural gas will aid conservation and will not interfere with national defense if a recapture provision is included in the contract, and that the preponderance of evidence favors gas use.

Problems of a gas purchaser in obtaining a certificate from the Federal Power Commission and obtaining a clear right-of-way across Pennsylvania are for the consideration of the bidders rather than WAA, the committee declared.

Rep. John J. Rooney, of New York, dissented, saying that the best use of the lines is for oil, as that will aid independent oil companies and break up a monopoly in oil transportation. He also charged that major oil companies are attempting to have the lines sold for gas in order to prevent this from happening.

The other four committee members said there is no evidence in the record to substantiate Rooney's belief and added that examination of WAA staff members failed to discover any factual basis for the January report giving preference to oil use.

For other news on the big-inch system, dealing with its emergency use for gas transportation this winter, see pages 101-102.

C.I.O. Statements That Industry Can Absorb Wage Increase Challenged

STATEMENTS by Congress of Industrial Organizations representatives that industry can stand a 25 per cent wage increase without increasing prices were challenged last week by A. E. Walker, president of National Supply Co., in a letter to Philip W. Murray, C.I.O. president.

Walker, head of a company employing some 10,000 persons and operating four oil-field equipment-manufacturing plants, gave profit figures of National Supply to show that such wage increase, coupled with higher costs by supplying companies, "would have to be met through higher prices on our products."

The complete letter follows:

Mr. Philip W. Murray, President,
Congress of Industrial Organizations,
1500 Commonwealth Building,
Pittsburgh 22, Pa.
Dear Mr. Murray:

According to recent press reports, a survey prepared by Robert R. Nathan for the Congress of Industrial Organizations states that industry can stand a 25 per cent wage increase without increasing prices. You are quoted as stating that the purpose of the analysis is "to set the facts before the bar of public opinion."

I am content to abide by the decision of public opinion if it is based on all the facts. Meanwhile, I would like to state some facts about The National Supply Co., of which the great majority of employes are members of unions affiliated with the C.I.O.

Although earnings of this company are probably above the average of all industry, in proportion to invested capital and volume of sales, it will make a net profit of less than $3,000,000 this year. Our total payroll for the year will be about $24,000,000. A 25 per cent wage increase would require an additional $6,000,000 for our employes. But that is not all. The cost of goods and services that we buy would also rise to reflect the higher labor costs of our suppliers. Obviously, these direct and indirect increases in our cost of doing business could not come out of a $3,000,000 profit; they would have to be met through higher prices on our products.

Mr. Nathan is quoted as saying that many consumers are being priced out of the market because of "an insatiable thirst for profits." I agree that consumers are being priced out of the market but, except in isolated cases, it is not for the reason that Mr. Nathan ascribes. Our common stockholders have not had a dividend since 1937, when they received a small one payable in stock. I wish you could convince them that the management of this company has "an insatiable thirst for profits."

You know and I know, that the first round of wage increases which occurred during price control, brought soaring prices. The immediate gain to the worker was more than lost as his cost of living went up. Do you really believe that a second round of wage increases, in the absence of price controls, would have less disastrous effects?

We have at all times tried to be a good and fair employer. In the past our company has enjoyed friendly relations with your unions. What are you trying to do to us, Mr. Murray? What are you trying to do to our employes, in whose welfare we have at least as great an interest as you? Sincerely yours,

The National Supply Co.,
A. E. Walker, president.

Davies Resigns, Ball Named OGD Head

A biographical sketch of Max W. Ball, new head of the Oil and Gas Division, is published on page 130, this issue.

WASHINGTON.—Ralph K. Davies has resigned as acting director of the Oil and Gas Division of the Department of the Interior.

He will be succeeded by Max W. Ball, petroleum consultant and author, who has recently been attached to OGD as a special consultant. Ball was scheduled to be sworn in as director some time this week.

Davies planned to remain in Washington a few days and then return to his home in California for the holidays. He has not announced his future plans but is expected to attend the January 21 meeting of the National Petroleum Council here, and he may be named a special consultant to OGD in order to be available for conferences on important matters.

Production Pioneers Plan Expansion of Membership

LOS ANGELES.—Plans for expansion of membership to all other oil areas of the country and for preparation of a historical record of the men and events prominent in California petroleum development were disclosed here December 13 at the year-end meeting of the Petroleum Production Pioneers. More than 400 senior and junior members of the organization attended.

Thirty years of service in some phase of the producing end of the of the oil business is the prerequisite for senior membership. Junior members may qualify with as few as 4 years' service.

Lou Bronzan, Baash-Ross Tool Co., was chairman of the entertainment committee with E. B. Fowks, Emsco Derrick & Equipment Co., assistant sergeant-at-arms of the association, serving as his chief lieutenant.

B. of M. Forecast Shows Gain of 4 Per Cent in 1947 Product Demand

WASHINGTON.—Total demand for all finished petroleum products in 1947 last week was estimated at 2,010,000,000 bbl. by the Bureau of Mines, an increase of approximately 4 per cent over the 1946 demand of 1,927,000,000 bbl. The increased demand estimate represents a gain of 26 per cent over 1941.

Production in 1947 was estimated by the bureau at 1,746,000,000 bbl. compared to an estimated total 1946 production of 1,730,900,000 bbl. Actual production during the first 9 months of 1946 was 1,293,900,000 bbl., and the bureau estimated production in the last quarter at 437,000,000 bbl.

An increase in crude imports and a decrease in exports of finished products were forecast by the bureau, which estimated 1947 crude imports at 89,000,000 bbl., against 87,200,000 bbl. in 1946. Exports of all petroleum products were estimated at 146,500,000 bbl. in 1947, against 158,100,000 bbl. in 1946.

The survey showed a gain of about 45,000,000 bbl. in stocks of refined oils during 1946 and attributed the increase to unexpected reductions in fuel-oil consumption due to industrial shutdowns, reduced military purchases, and mild fall weather. Crude runs to stills reached a peak of 4,860,000 bbl. daily in the third quarter and dropped to an estimated level of 4,730,000 bbl. in the fourth quarter.

Predicting a necessary adjustment in the stock situation, the report said it "does not seem feasible to reduce runs to so low a level in the first quarter of 1947 as to require operations that might strain refinery capacity in the last half of the year, particularly if total demand should exceed present estimates."

The bureau forecast crude runs of 4,700,000 bbl. daily in the first quarter, basing the estimate on "an adjustment of product yields to produce a maximum normal seasonal increase in gasoline stocks and a maximum decrease in fuel-oil and kerosene stocks.

Noting that total demand for motor fuel "continues at an unexpectedly high level," the bureau forecast a demand of 805,000,000 bbl. in 1947 against an estimated total of 773,600,000 bbl. in 1946. Demand rose from 171,400,000 bbl. in the first quarter of 1946 to 201,500,000 bbl. in the second quarter, 208,600,000 bbl. in the third quarter and was estimated at 192,100,000 bbl. in the last quarter.

Panhandle Eastern Gas Supply Allocated in FPC Order

WASHINGTON.—A schedule for allocating gas among customers of the Panhandle Eastern Pipe Line Co. during periods of peak demand this winter has been ordered by the Federal Power Commission.

Panhandle has installed transmission-system capacity capable of delivering approximately 405,000,000 cu. ft. of gas per day, but firm-sales requirements totaling 440,000,000 cu. ft. on a zero-temperature day. The need for control of deliveries to assure continuity of supplies for domestic and other necessary general-service requirements was foreseen some time ago and was the subject of hearings before the FPC in Chicago and Washington from October 23 to November 19, followed by a conference with state regulatory commissions in Chicago December 4-5.

The emergency rules and schedule were formally filed by Panhandle December 9, but they follow a proposal made by the FPC staff during the hearings and the voluntary agreement reached at the Chicago conference. The actual curtailments will be made by the distributing companies purchasing gas from Panhandle and by the state commissions having jurisdiction.

Delivery curtailments are to be made in four steps. The first step is a 50 per cent reduction to interruptible-industrial customers of Panhandle and interruptible deliveries to distributors, all of whom are listed in the order. The second step is a further 10 per cent reduction to these same customers.

Step three is a specified maximum delivery per day to certain listed customers, including aggregate deliveries to distributing companies for other than general service. Step four is a still further reduction in the maximum deliveries to the same customers listed for the third step. Total gas curtailments from the third and fourth steps are not as great as from the first two.

After all four curtailments have been effected, Panhandle will not be obligated to supply more gas to any customer than the amount specified for each one in the FPC order. The total of these maximum delivery obligations adds up to 405,000,000 cu. ft. per day.

NEXT WEEK—The International Number

The Journal's year-end issue, to be published next week, will afford the reader a roundup of world developments during the first full year of peace following a world war. The issue will be featured by a 36-by-48-in. "Journal-Guide to World Oil," a four-color-process insert map that sets a new high for oil-journal cartography. This handsome Journal-Guide took months in preparation, and consists of enlarged maps of the world's important oil-producing and refining countries surrounding a complete smaller-scale map of the world in the center. Shown on the individual maps are producing and refining centers, and pipe-line routes. Brief digests of facts and figures accompany the maps, making the whole a streamlined encyclopedia of oil. Also featured in the issue is the resumption of an erstwhile regular feature, interrupted during the war years—the Journal's survey of world oil fields, and refineries. These 10½ pages list all the important producing and refining areas outside the United States, excluding Russia and Russia-controlled nations for which official figures are not yet available. Technical and operating articles describing techniques and processes in other countries are also presented, as well as economics reviews.

Offshore Areas Leased

AUSTIN.—The School Land Board last week announced acceptance of bonus bids on mineral leases totaling $962,589 on approximately 200,000 acres, most of which is submerged coastal areas. Phillips Petroleum Co. submitted the three highest bids, all of them for leases on tracts in Nueces Bay, Nueces County. These were: $47,896 for 785 acres in Tract 44; $44,419 for 728 acres in Tract 43; and $42,641 on 609 acres in Tract 37.

Atomic Energy, Industrial Processing Occupy Texas Chemists

by Arch L. Foster

DALLAS. — The significance and prospects for utilization of atomic energy for military and industrial uses occupied much of the attention of Texas chemists assembled here December 12-13, under the auspices of the Texas division of the American Chemical Society. Under the leadership of Dr. Vladimir Kalichevsky, of Magnolia Petroleum Co., and chairman of the Texas - Louisiana-Gulf section of the society, the more than 400 chemists covered practically all phases of petroleum refining and technology as well as presenting a score or more of important papers from industrial and university laboratories covering many other chemical fields in Texas' rapidly growing chemical industry.

The Baruch and other announced plans for control and harnessing of atomic energy and for preventing this great development from becoming a menace to the world still leave some room for improvement, Dr. T. Harrison Davies, Institute of Nuclear Studies, University of Chicago, indicated in addressing a luncheon session of the meeting. Outlining the high points of the Baruch plan along with others, Dr. Davies indicated the direction in which developments for control will probably take.

Dr. Davies stated that the study and development of the "denaturants" which will render atomic fissionable materials nonusable for military purposes while leaving them useful for other less damaging applications is under way and holds great promise. The U. S. atomic-development authority will take over all plants and laboratories working on atomic-energy projects, according to statements made at the meeting.

At the banquet session, the physical and the chemical implications of nuclear energy were discussed at length by Dr. G. W. Watt and Dr. Robert J. Little, both of the University of Texas, who indicated some of the "limitless" possibilities of atomic energy and its harnessing.

Evaluation of catalysts for their efficiency in cracking has become one of the most important jobs of the laboratory, A. R. Rescorla, of Cities Service Refining Corp., showed in presenting methods for doing this work. Catalysts are rated both directly, by carrying out various activity tests by cracking oils in a test unit, a procedure called "D plus L evaluation." They are also tested indirectly by analysis, making determinations of density, particle size, and chemical analysis for alumina, silicia, iron, etc.

Three hundred grams of commercial silica gel will remove up to 10 grams of acetic acid from solutions containing 100 p.p.m., stated D. A. Shock and Norman Hackerman, University of Texas, in giving results of a study for removal of acidic components in hydrocarbon solutions. This work has been undertaken in connection with corrosion in condensate wells and lines; the results are considered to indicate applicability of the reagent to the purification of other materials such as used lubricating oils and other products. Fifty gallons of a hydrocarbon solution of naphthenic acids of only 5 p.p.m., when passed through the same gel showed recovery of 0.84 grams of acid before an appreciable loss of activity was noted.

Application of "heavy carbon," recently announced by Sun Oil Co. scientists, to the study of plant metabolism is showing interesting results, G. S. Rideau, of the University of Texas, said. Exposure of bean and radish-plant tissue to light and to carbon dioxide atmospheres enriched with the C^{13} isotope tracer shows a tendency toward an equilibrium of the tracer in the different plant tissues, in which the amount of heavy carbon present becomes as high as 38 per cent of the total carbon present in the material.

DIGESTS— of papers presented at A.C.S. Dallas Meeting

Optimum Charging Rates for Laboratory Low Temperature Fractional Distillation

C. E. STARR, JR., J. S. ANDERSON, and V. M. DAVIDSON, Standard Oil Co. of N. J., Louisiana division, Baton Rouge.

ANALYSES of mixtures of light hydrocarbon gases and gases such as hydrogen, nitrogen, oxygen, and carbon monoxide are generally conducted first by segregation of fractions by low temperature distillation, and second, by analysis of the individual fractions. The lightest components are taken overhead from the distillation column during the charging of the sample. Published procedures for equipment operation do not ordinarily include sufficiently detailed instructions for charging samples of widely varying compositions to insure obtaining overhead fractions of maximum purity with minimum charging time.

A study has been made of charging rates for samples ordinarily encountered in petroleum-refining plants. Overhead samples taken at different charging rates have been analyzed by mass spectrometer to determine amount of contamination with higher-boiling constituents. Results indicate that charging rates much higher than ordinarily employed may be used with equal accuracy. and considerable economy of time. For some special applications distillation rates may be increased several fold over rates now generally employed.

Catalyst Analysis for Catalytic Cracking of Petroleum

A. R. RESCORLA, Cities Service Refining Corp.

IN the evaluation of catalytic-cracking processes, it has become necessary to develop several new testing procedures as well as to adopt older methods of analysis. The indirect analyses consist of analyzing such properties of the catalyst as density, particle size, and chemical analysis for such common elements as Si, Fe, and Al. The direct evaluations include the various laboratory activity tests in which the catalyst is subjected to actual cracking. These analyses are commonly referred to as D plus L evaluation. Recently developed a series of empirical methods, such as aromatic absorption for rating catalyst activity. The data are presented to indicate the relationship between the various properties of the catalyst and activity measurements. This is extended to include changes in properties of catalyst resulting from use.

Possible trends are outlined and it is forecast that the number of catalyst procedures will be reduced as more data are available and the number of catalytic-cracking units are increased.

Radiography in the Oil Industry

J. R. MUSGRAVE and H. R. HARNER, The Eagle-Picher Lead Co., Joplin, Mo.

RADIOGRAPHY is not new. Henri Becquerel discovered that a photographic plate in contact with pitchblende would be exposed. As a direct result of this first radiograph the Curies discovered radium in pitchblende.

A radiograph is not a shadowgraph, nor should it be compared to one. The light and dark areas in a film vary inversely as the gamma-ray coefficient. A steel casting with a porous area as a defect will show dark on the film in this area.

A carbon-steel pipe lined with a stainless-steel sleeve can be detected by a radiograph. The gamma-ray coefficient of absorption being different for both metal will product a light line for the carbon steel and a still lighter line for the stainless steel.

The most desirable source of gamma ray is radium. Radium belongs to the uranium-radioactive family. Radium disintegrates emitting alpha, beta, and gamma rays. Alpha particle is a helium atom with two protons attached. The beta particle is a high-velocity electron and the gamma ray is a quantum.

(Continued on page 134)

THIS 1946 S M T W T F S WEEK

INTERNATIONAL—What is expected to be the largest oil deal of all time reported in the making with the purchase of approximately 40 per cent of Arabian American Oil Co. by Jersey Standard and Socony-Vacuum. . . . Involved is Arabian American's vast Saudi Arabian concession now producing more than 200,000 bbl. daily and considered to have reserves which may equal those of the entire United States. . . . State Department reportedly has approved the transaction which will widen the markets for Arabian oil, particularly in Europe. . . . Negotiations focus attention on the "Red Line Agreement" of 1928 under which the two purchasing companies and other partners in Iraq Petroleum Co., Ltd., agreed not to operate in certain Middle East areas, including Saudi Arabia, except for joint account. . . . Negotiations presumably proceeding on assumption that the agreement was voided by status of the French company, Compagnie Francaise des Petroles, during the war. . . . ¶Texas Petroleum Co. brings in an important discovery, Velasquez 1, in Colombia. . . . ¶Socony-Vacuum's Venezuelan subsidiary plans to begin work in about 2 months on 27-mile pipe line from Guario-Guico area to a junction with Sinclair's Santa Barbara-Puerto La Cruz line. . . .

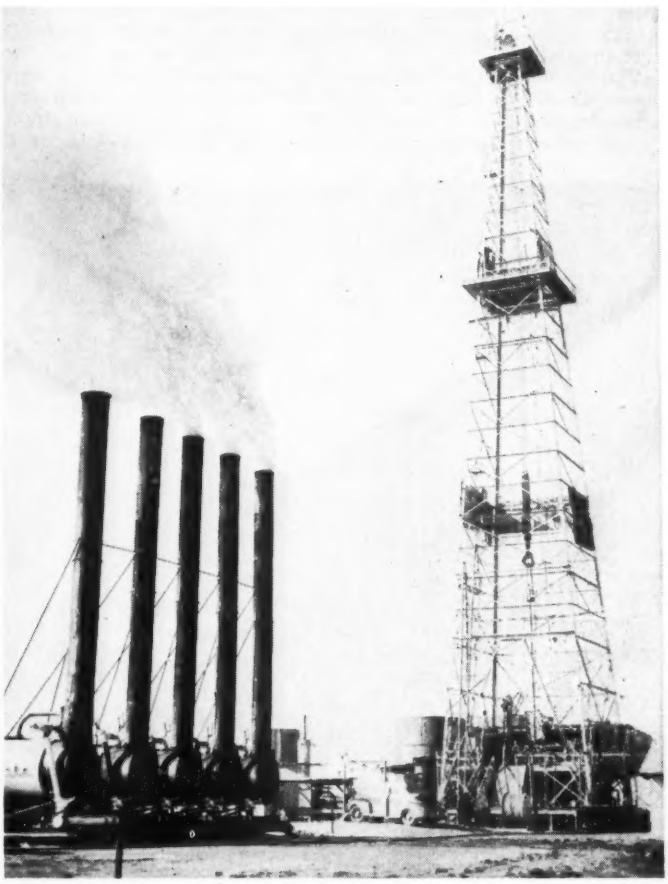
THE BIG-INCH—House surplus-property committee, in an unusually prompt report, recommends sale of the system to the highest bidder with no restrictions as to use for oil, gas, or both. . . . Committee investigation and report considered a victory for advocates of gas use. . . . Report refutes contention sale for oil use is needed to break "oil monopoly." . . . FPC names group of gas-industry executives to assist in allocation of gas made available from emergency operation of the system this winter by Tennessee Gas & Transmission. . . .

NATURAL GAS— FPC issues schedule allocating gas among Panhandle Eastern's customers this winter. . . . Commission praises effective cooperation of state regulatory agencies and distributing utilities in solving shortage problem. . . . ¶FPC roundup of approved projects shows 4,465 miles of new gas pipe line and 276,535 compressor hp. authorized in 15-month period ending September 30. . . .

PREDICTIONS—Interstate Oil Compact Commission economics committee forecasts 3 per cent increase in demand for all oils in 1947 but says this can be met by production about 90,000 bbl. daily under the 1946 average. . . . ¶Bureau of Mines 1947 forecast predicts gain of 4 per cent in demand for all petroleum products and says production will rise to 1,746,000,000 bbl.—total for the year—15,100,000 over 1946.

EXPLORATION—Madison lime production in North Cut Bank field, Wyoming, extended 2 1/2 miles south. . . . ¶Exhausted Wilcox sand oil well in the Greater Seminole field, Oklahoma, flows large volume of gas while casing is being pulled. . . . Flow of 7,000,000 cu. ft. may indicate presence of rich gas reservoir in the old field. . . . ¶Texas School Land Board announces acceptance of bonus bids on mineral leases totaling $962,589 on approximately 200,000 acres. . . . Phillips Petroleum Co. submits three highest bids. . . .

THE GOVERNMENT—Max W. Ball prepares to take over as director of the Oil and Gas Division of the Department of Interior. . . . Future plans of Ralph K. Davies unrevealed. . . . ¶Reports in Washington indicate Justice Department may drop the 6-year-old "Mother Hubbard" antitrust action against the A.P.I. and major oil companies. . . .



Holder of the new world's drilling-depth record, Pacific Western Oil Corp. 1 National Royalties last week ran into difficulty with a stuck drill pipe. The test is located 7 miles east of Lost Hills in Kern County, California. It ran into trouble at 16,668 ft., 13 ft. deeper than the previous record set by Phillips Petroleum Co.'s 3 Schoepps in Brazos County, Texas, in 1945. The new record test, still shut down at last reports, was spudded in December 1945

World's Largest Oil Deal Pending in Arabian American Negotiations

by Warren W. Burns

NEW YORK.—When Standard Oil Co. (N.J.) and Socony-Vacuum Oil Co., Inc., complete their negotiations with Arabian American Oil Co., whereby the two former companies will acquire approximately 40 per cent of the vast Saudi Arabian crude-oil concessions, the new partners may find that in the bonanza Abqaiq field alone the probable reserves are 4,000,000,000 bbl. Arabian American's engineers and geologists are not yet ready to define the Abqaiq field, but the present estimate of reserves there is considered conservative.

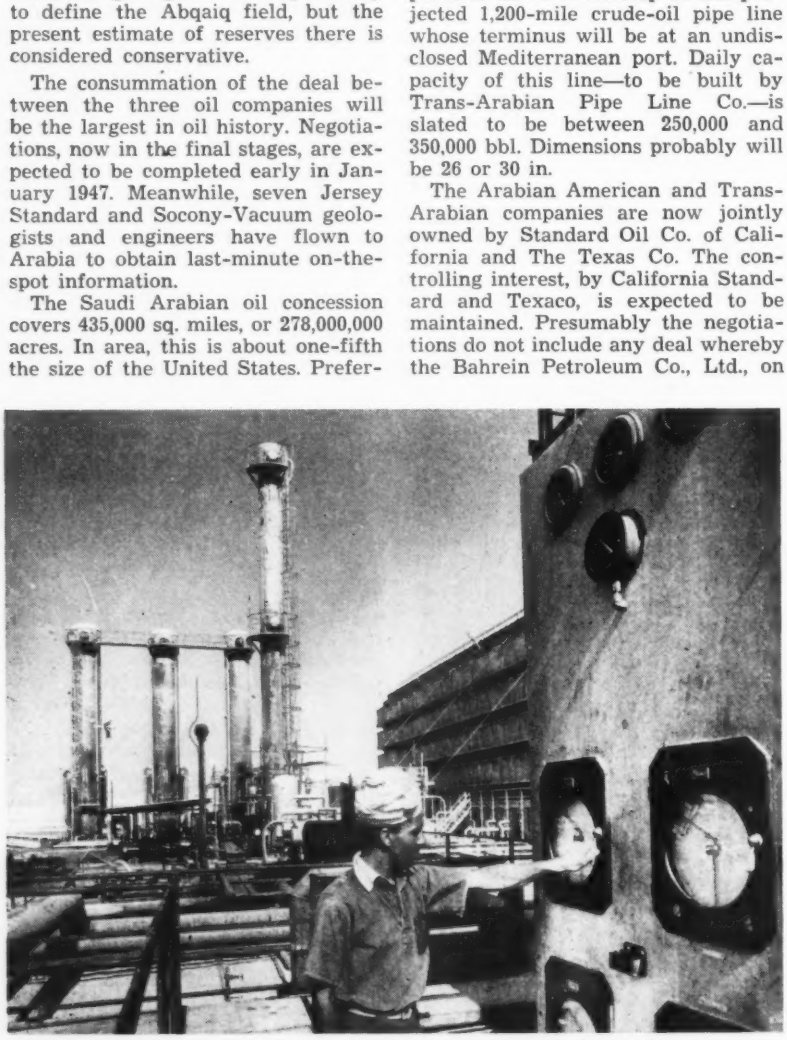
The consummation of the deal between the three oil companies will be the largest in oil history. Negotiations, now in the final stages, are expected to be completed early in January 1947. Meanwhile, seven Jersey Standard and Socony-Vacuum geologists and engineers have flown to Arabia to obtain last-minute on-the-spot information.

The Saudi Arabian oil concession covers 435,000 sq. miles, or 278,000,000 acres. In area, this is about one-fifth the size of the United States. Preferential rights are held on another 74,880,000 acres in Arabia.

Current negotiations to expand ownership in Arabian American's Middle East facilities also include plans to share ownership in the projected 1,200-mile crude-oil pipe line whose terminus will be at an undisclosed Mediterranean port. Daily capacity of this line—to be built by Trans-Arabian Pipe Line Co.—is slated to be between 250,000 and 350,000 bbl. Dimensions probably will be 26 or 30 in.

The Arabian American and Trans-Arabian companies are now jointly owned by Standard Oil Co. of California and The Texas Co. The controlling interest, by California Standard and Texaco, is expected to be maintained. Presumably the negotiations do not include any deal whereby the Bahrein Petroleum Co., Ltd., on Bahrein Island, nearby the Arabian mainland, will expand its ownership. Bahrein Petroleum is also owned by California Standard and Texaco.

Arabia's King Ibn Saud and the U. S. State Department have registered approval of the proposed expanded ownership plans. And while State Department approval was not necessary, the companies welcomed this official sanction as the U. S. Government blessing obviously strengthens the hands of the private interests. Moreover, the State Department's diplomatic support emphasizes—an important point insofar as American oil companies are concerned—the open-door principle and equality of opportunity for U. S. petroleum interests in foreign countries. The State Department approval also serves to indicate this Government's views as to the need of large-scale expansion of holdings in foreign oil reserves by U. S. nationals.



These stabilizer units are at Dhahran in Saudi Arabia and are a part of the property involved in the current negotiations by which Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co., Inc., are to acquire approximately 40 per cent interest in Arabian American Oil Co.

Held Restrictive Agreement

The U. S. State Department also is understood to have approved the negotiations because of the implication that the "Red Line Agreement" is dead. While readily admitting that this agreement does not constitute a cartel per se, State Department sources hold that it nevertheless is a restrictive agreement. The State Department's interest in the current negotiations stems from 1920 when after 7 years of U. S. government insistence that American oil companies should not be precluded from participation in development of Iraq's oil, American companies became partners in Iraq Petroleum Co., Ltd.

Whether the Jersey Standard and Socony-Vacuum negotiations will be approved by the British, Dutch, and French, with whom these two American companies (operating as the Near East Development Corp.), are partners in Iraq Petroleum Co., Ltd., seems to be another question and one which reportedly has caused several headaches. However, the barrier, in form of the "Red Line Agreement," may have been hurdled by the American companies in the belief that the wartime status of the French partner in Iraq Petroleum, Compagnie Francaise des Petroles, as an enemy alien nullified the agreement.

The significance of the "Red Line

Agreement" in the current negotiations between Jersey Standard, Socony-Vacuum, and Arabian American has probably dwarfed all other considerations, that is, insofar as the first two companies are concerned. This is largely due to the fact that the "Red Line Agreement," first drawn up in 1911 and subsequently reemphasized in 1928, provides that any crude-oil production arrangements entered into by any of the partners in Iraq Petroleum Co., Ltd., in lands comprising the old Turkish Empire—circumscribed by a red line—should be for the joint account of all partners in Iraq Petroleum.

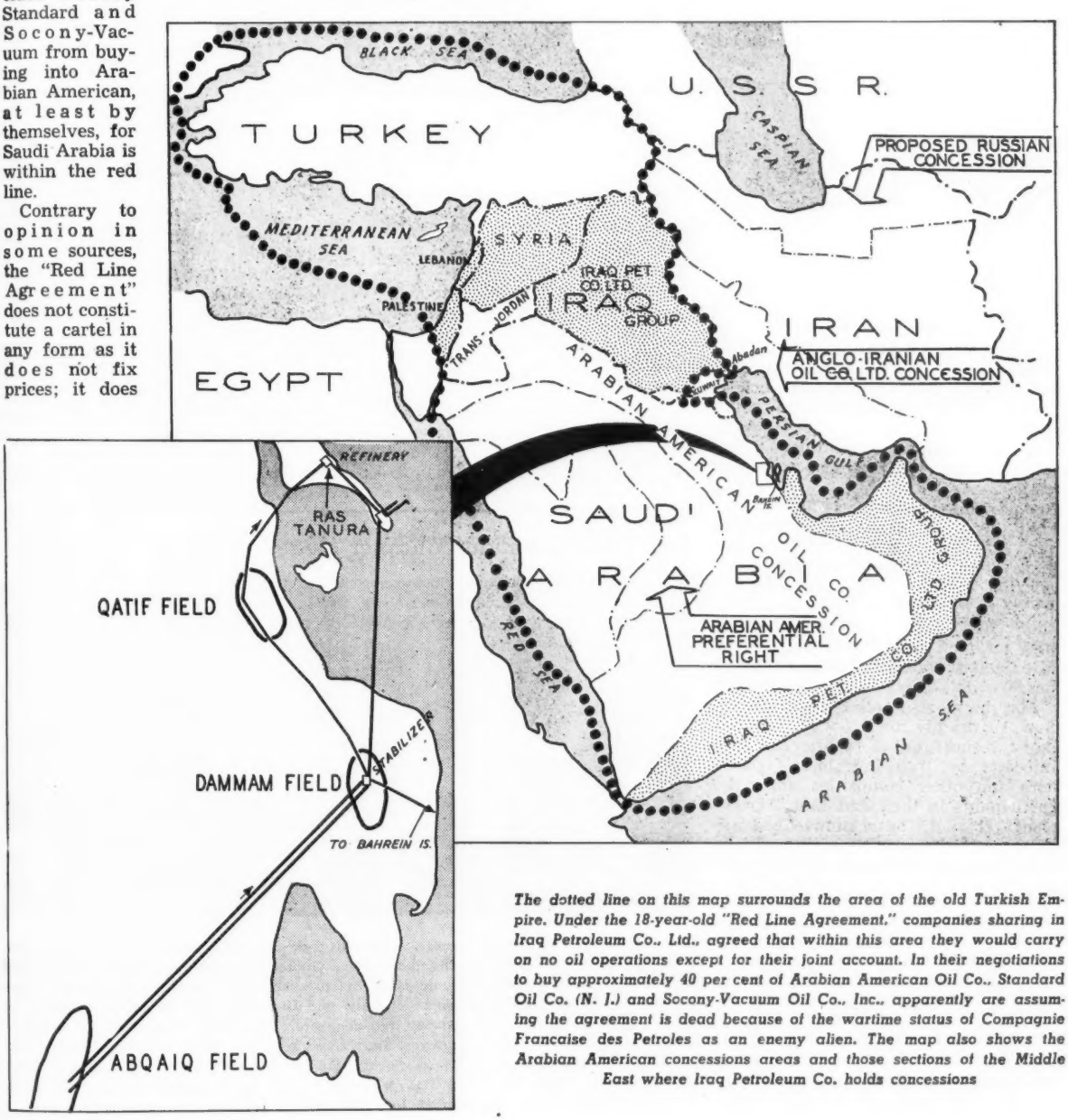
Therefore, if the agreement is still in force, although apparently it is not, it would preclude Jersey Standard and Socony-Vacuum from buying into Arabian American, at least by themselves, for Saudi Arabia is within the red line.

Contrary to opinion in some sources, the "Red Line Agreement" does not constitute a cartel in any form as it does not fix prices; it does not restrict production. It merely provides for equal opportunity for all Iraq Petroleum Co., Ltd., partners, who, besides Jersey Standard and Socony-Vacuum, are: D'Arcy Exploration Co., Ltd., a subsidiary of Anglo-Iranian Oil Co., Ltd., 56 per cent owned by the British Government; Anglo-Saxon Petroleum Co., a British unit of the Royal Dutch-Shell; Compagnie Francaise des Petroles, S. A., 35 per cent owned by the French Government; and C. S. Gulbenkian and associates. Aside from the Gulbenkian interest of 5 per cent, each of the other partners—remembering that Jersey Standard and Socony-Vacuum constitute a single unit as the Near East Development Corp.—holds 23.75 per cent of the stock.

International

When British, French, and German interests reached an agreement in 1911 for participating in matters concerning petroleum production within the areas of the old Turkish Empire as it existed before World War I, a hypothetical red line circumscribed Turkey, Syria, Lebanon, Palestine, Trans-Jordan, Iraq, and the Arabian countries, including Oman, Trucial Oman, Yeman, Hadhrmaut, Saudi Arabia, and Bahrein. Kuwait was omitted.

At the close of the first World



The dotted line on this map surrounds the area of the old Turkish Empire. Under the 18-year-old "Red Line Agreement," companies sharing in Iraq Petroleum Co., Ltd., agreed that within this area they would carry on no oil operations except for their joint account. In their negotiations to buy approximately 40 per cent of Arabian American Oil Co., Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co., Inc., apparently are assuming the agreement is dead because of the wartime status of Compagnie Francaise des Petroles as an enemy alien. The map also shows the Arabian American concessions areas and those sections of the Middle East where Iraq Petroleum Co. holds concessions

International

WORLD-WIDE OIL DEVELOPMENTS

War, the German interests in the Turkish Petroleum Co., Ltd., (now the Iraq Petroleum Co., Ltd.) passed to Allied hands.

The "Red Line Agreement," which Jersey Standard and Socony-Vacuum, both as a corporate entity in the Near East Development Corp. and as parent companies individually, signed, is important, for because of it, California Standard, an outsider, acquired the Arabian concession. Moreover, it was also because of the "Red Line Agreement" that Eastern Gulf Oil Co., which held the Bahrein concession, and which at the time was a partner in Iraq Petroleum, transferred its Bahrein holdings to California Standard. In 1936, The Texas Co. acquired 50 per cent of California Standard's interest in Arabia and Bahrein.

I.P.C. Concessions Extensive

It is interesting to note that Iraq Petroleum Co., Ltd., through its associated Petroleum Concessions, Ltd., and affiliates, holds Middle East oil concessions which its geologists believe may even dwarf Arabian American's oil concessions.

Qatar, the Trucial Coast, Oman, and Dhufar, independent sheikdoms where Iraq Petroleum holds concessions, may get into production in the not-too-distant future. Qatar wells are now being reconditioned, and plans made for drilling additional tests.

And while it appears at this writing that these two American oil companies will consummate their negotiations with Arabian American, The Journal was told on excellent authority that if the deal is consummated the "Red Line Agreement" will play an even more important role in Middle East oil in the future than it has to date.

For, in view of other negotiations now reportedly under way, involving a reshuffling of Middle East oil interests by Iraq Petroleum's partners and other companies not now participants in the "Red Line Agreement," it might be acknowledged by all concerned that a rewriting of the agreement would be expedient. At present a London meeting involving these questions and the agreement is in session. The U.S. State Department's Charles Rayner, petroleum adviser, and John Loftus, petroleum division chief, have been unofficial observers at this meeting.

Meanwhile, the Jersey Standard and Socony-Vacuum negotiations probably will not be closed until a report is made by the seven Jersey Standard and Socony-Vacuum officials who went to Arabia. Eugene Jablonski, chief geologist; J. B. Middleton, foreign refinery manager; and C. A. Moon, chief petroleum engineer represent the Socony-Vacuum company. I. S. Salnikov and E. S. Neal, from the production division, A. C. Savage comptroller's office, and L. Smith represent Standard of New Jersey.

NEW YORK.—Iraq Petroleum Co., Ltd., was reported Tuesday to be raising some $70,000,000 from its interest-holding companies for use in doubling its Kirkuk-Haifa and Tripoli pipe-line facilities and expanding exploration and development of its extensive concessions, particularly around Basra and Mosul.

Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co., Inc., were said to be contributing about $13,400,000 to the expanded IPC operations. The IPC partners, including also Anglo-Iranian Oil Co., Ltd., Cie. Francaise des Petroles, Royal Dutch-Shell, and the Gulbenkian interests, were reported supplying funds on a percentage basis. Jersey Standard and Socony-Vacuum, it was said, may not make their entire contribution of $13,400,000 at once, since a definite determination of the sum needed is being decided by IPC's stock-issue committee in London.

The No. 10 Abqaiq, the newest well in the Abqaiq field, and located about 6,000 ft. west of 5 Abqaiq, is the lowest well in the field by 600 ft., reaching 1,450 ft. below the crest of the oil formation. Water has not yet been found here. Drilling of this well indicates that the size of the field has been greatly extended, both geographically and vertically. The well is now producing, from a depth of 7,500 ft in the Arab zone, 10,000 bbl. daily of 37°-gravity (A.P.I.) crude oil.

Including the No. 10 Abqaiq, nine wells here are producing 100,000 bbl. daily. Upwards of 48,000 acres have been proved. Unofficial reports are that reserves in this field alone may total 4,000,000,000 bbl. Abqaiq is located 45 miles southwest of Dhahran, site of the discovery well in 1938.

In the Dammam field, northeast of Abqaiq, 44 wells are producing 100,000 bbl. daily. Proven reserves here are 800,000,000 bbl. At the Qatif field, northwest of Dammam, one well is producing 3,500 bbl. daily. When more knowledge is gained of the Abqaiq field, indications are that more drilling will be done at Qatif.

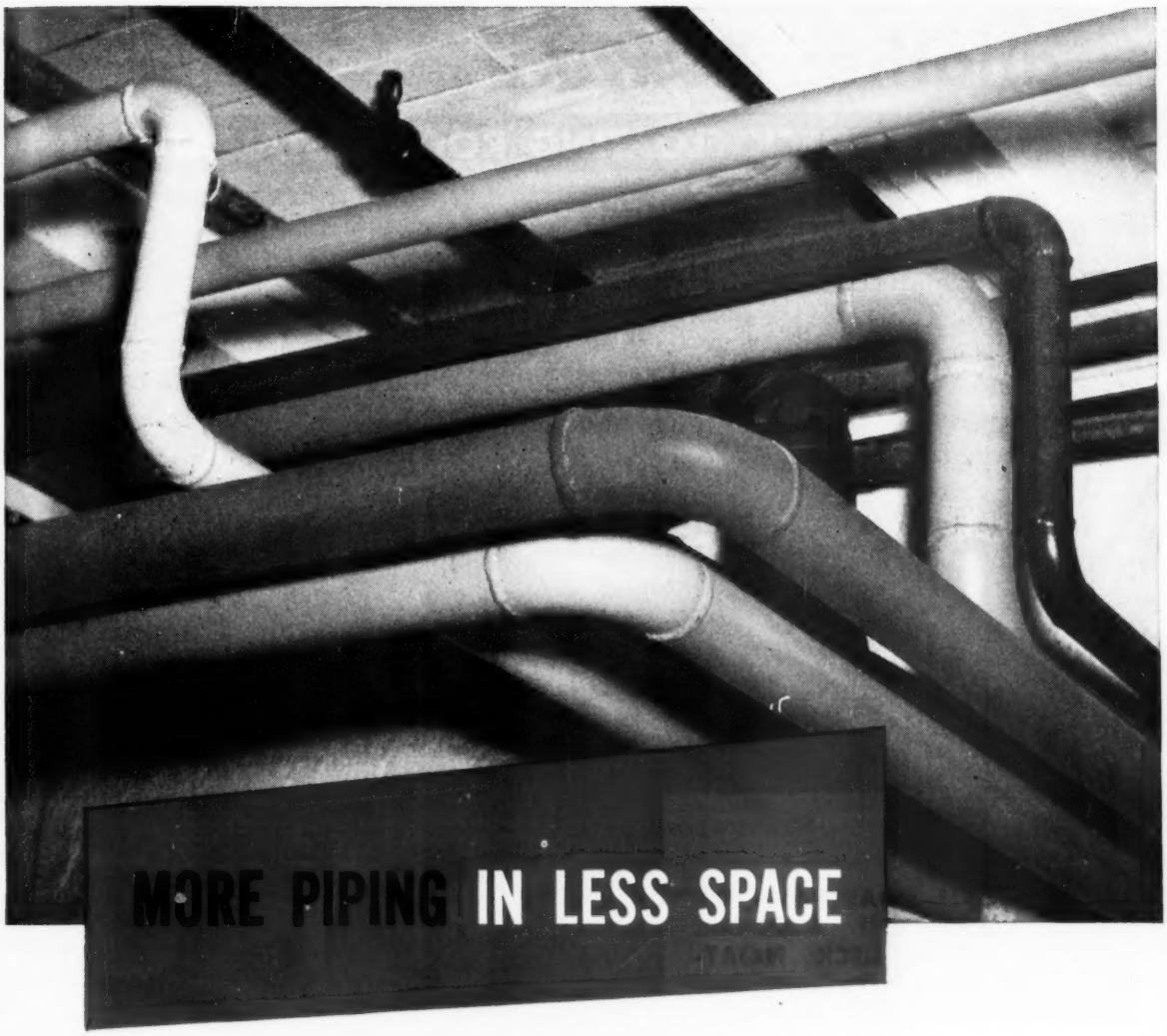
In Abqaiq, four wells currently are being drilled; two rigged; one building derrick; and two standing. In Dammam one additional well is being drilled.

Arabian American's Ras Tanura refinery, originally designed to run 50,000 bbl. daily is now refining approximately 100,000 bbl. The Bahrein refinery—which presumably will not figure in on the current negotiations—is refining 115,000 bbl. daily.

Ras Tanura obtains its crude oil from two pipe lines which connect with Dhahran and Qatif. The marine terminal loads products into tankers at a rate of 10,000 to 12,000 bbl. per hour. Crude oil is loaded at the rate of 9,000 bbl. per hour. Improvements

New Dallas Nomads Chapter Meets

The newly organized Dallas chapter of Nomads held a party and buffet supper December 13 at the Petroleum Club in the Adolphus Hotel. George E. B. Peddy, Houston attorney and an officer in both world wars, addressed the meeting on the international complications involved in the military government of Italy and Germany and the battle of ideas for world supremacy between totalitarian and democratic ideologies. Seated at the speakers' table are: Shep Miers, Tulsa, Southwest Supply Co., secretary of the national Nomad board of regents; Peddy; N. A. Endicott, Continental Supply Co., president of the Dallas chapter; C. W. Thornhill, Thornhill-Craver Co., president of the Houston chapter; and William G. Green, Engineering Laboratories, Inc., chairman of the national board of regents



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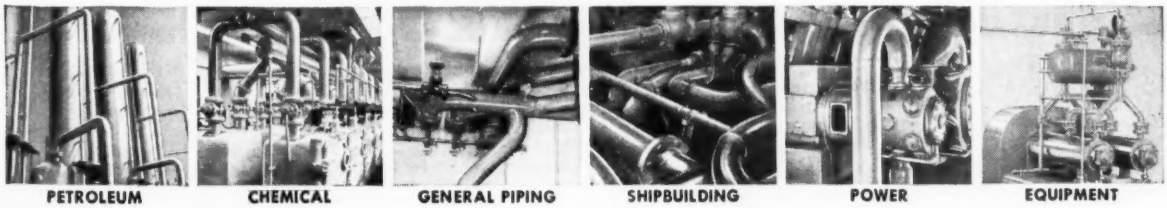

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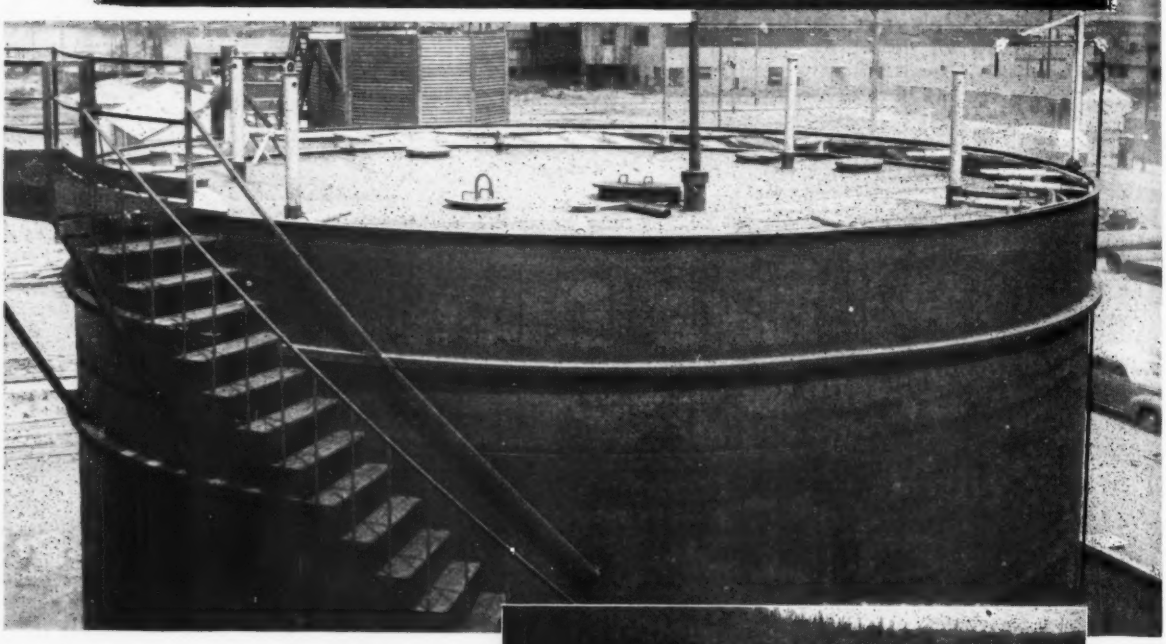
another HORTON

DOUBLE-DECK FLOATING ROOF INSTALLATION!



. . . . PACIFIC COAST ASPHALT PLANT USES TWO 4,500-bbl. HORTON DOUBLE-DECK FLOATING ROOF TANKS FOR STORING NAPHTHA AND OTHER PRODUCTS

Because of the efficiency and practicability of the Horton Double-Deck Floating Roof, it has become a familiar sight throughout the petroleum industry. The large photo above shows a recent Horton Floating Roof installation at an asphalt plant. It is a typical example of how this roof is used to prevent evaporation losses and reduce the danger of loss from fire.

The Horton Double-Deck Floating Roof eliminates the vapor space above the liquid surface in the tank, which is present in all fixed-roof tanks. By accomplishing this function it *automatically* reduces evaporation losses and fire hazard. A floating roof rides up and down on the liquid surface in the tank, thereby eliminating the vapor space above the liquid *at all times.* The Horton seal closes the space between the roof deck and tank shell and prevents the escape of vapors at that point. On many tanks storing volatile products, a floating roof will pay for itself in a short time by the amount of evaporation loss it prevents.

Horton Double-Deck Floating Roofs are furnished completely equipped with all the accessories necessary for operation. This includes adjustable roof supports, ladder, gauge hatch, automatic bleeder vent, roof drain and manholes.

In addition to the two Horton Double-Deck Floating Roof tanks shown above we also built two 4,500-bbl. cone roof tanks, two 11,000-bbl. tanks, one 31,000-bbl. and two 80,000-bbl. cone roof tanks at this plant.

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New York, 6 ..... 3347-165 Broadway Building
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Los Angeles, 14 ..... 1423 Wm. Fox Building
Atlanta, 3 ..... 2154 Healey Building
Birmingham, 1 ..... 1536 North 50th Street
Tulsa, 3 ..... 1606 Hunt Building
Houston, 1 ..... 5619 Clinton Drive
Philadelphia, 3 ..... 1615-1700 Walnut Street Building
Washington, 4 ..... 703 Atlantic Building
San Francisco, 11 ..... 1254-22 Battery Street Building
Detroit, 26 ..... 1514 Lafayette Building

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are expected to double this figure. At present Arabian American is selling crude to Argentina and some to Italy. Expectations are that when Jersey Standard and Socony-Vacuum become part owners of Arabian American either a new refinery will be built in Arabia, the Ras Tanura refinery enlarged, or that a refinery will be built somewhere on the Mediterranean Coast. Some opinions are that all three will be future projects.

A 14-in. pipe line is transporting Abqaiq crude to Dhahran, and a second line of 14-in. pipe will be completed by next June. The two lines will have a daily capacity of 200,000 bbl. From Dhahran, crude from Abqaiq can be sent either to the Ras Tanura refinery and terminal, or under water, through a 32-mile 12-in. line, to the refinery on Bahrein Island. The Arabian American company has produced its first 100,000,000 bbl. of crude oil in Arabia.

Practices of the company in assisting the Arabian Government and the people of Saudi Arabia already are having their effect in improving the welfare of the entire region. The rate of improvement will be speeded up as the oil development grows and prospers.

It is certain that Jersey Standard and Socony-Vacuum, through their already wide marketing activities in these areas expect to broaden their markets as a partner of Arabian American. "The deal is a natural," as one Socony-Vacuum official remarked, "for we need more crude."

Struggle for Markets Seen

Moreover, competition for European, African, and Asiatic oil markets is certain to be keen between Jersey Standard and Socony-Vacuum on the one hand, operating as Standard-Vacuum, and California Standard and Texaco on the other, operating as California Texas Oil Co., Ltd., a subsidiary of Bahrein Petroleum.

Recently, California Standard and Texaco organized the Caltex Oil Products, Ltd., with E. A. Beverly as president. Whether this company's marketing activities will be confined to lubricants, or another company organized to handle expanded marketing in Europe and throughout the Eastern Hemisphere is not known.

But early this week it was revealed that California Standard will acquire a 50 per cent interest in all of Texaco's extensive European and African marketing organizations.

This deal has been under consideration for a long time and is not connected with the Jersey Standard, Socony-Vacuum negotiations to buy into Arabian American. In fact, the marketing deal is slated to be consummated regardless of the outcome of other negotiations.

Until now Caltex marketing operations have been largely confined to areas east of the Suez Canal. The company had no European marketing facilities. When present marketing negotiations between California Standard and Texaco are completed, they will have virtually round-the-world oil operations. Standard-Vacuum already enjoys this status. Since the war, Standard-Vacuum and Caltex have become partners in military directed oil distribution programs in the Philippines and Japan. Currently a similar set-up is being studied for Germany.

Deal to Aid Intava

A long-range tactical advantage which Jersey Standard and Socony-Vacuum will gain through acquiring Arabian American oil ownership is being able to supply aviation gasoline and other aviation petroleum products to Intava, Inc., their worldwide aviation oil-products distribution agency. There is keen competition here, especially with the Shell group.

Another consideration which Jersey Standard and Socony-Vacuum may be confronted with shortly is renegotiating contracts in the Netherlands East Indies, in view of the fact that more than 95 per cent of Sumatra is now controlled by the new Republic of Indonesia. Dr. A. K. Gani, Indonesian minister of economics, is on record as stating that former contracts with the Dutch will not be recognized.

International

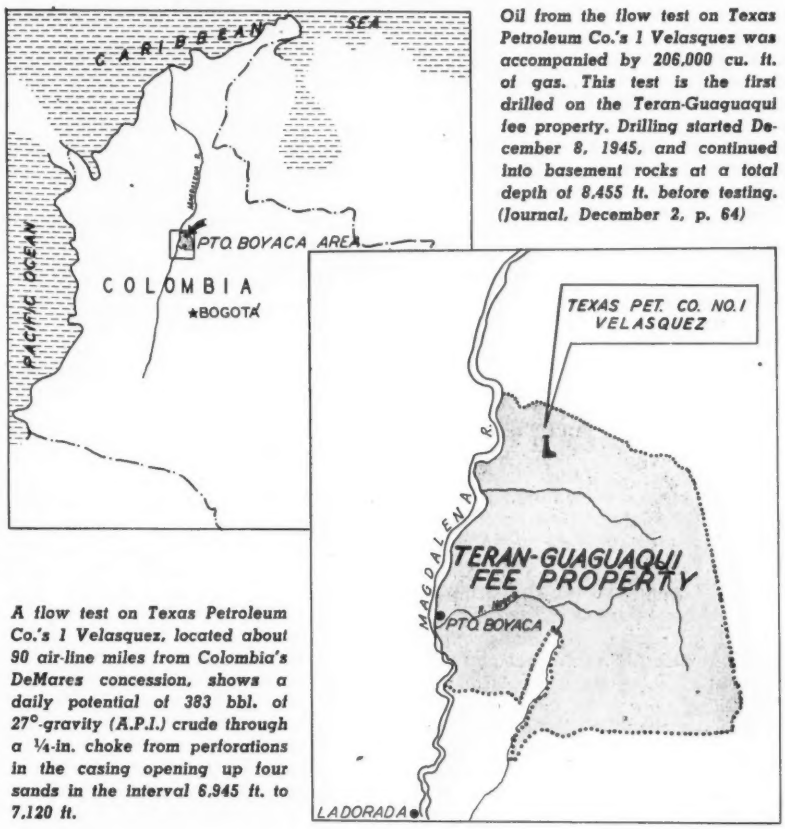
In the meantime, these companies will be assured of crude oil from Arabia.

More than $150,000,000 has been invested in the Saudi Arabian concession and further expenditures will be necessary in the next several years. Next spring construction is scheduled to commence on a deep-water harbor at Dammam, making this the second modern port in Arabia, the first being Ras Tanura. It is estimated that this project will be finished 18 months after actual construction gets under way.

South American Oil Congress Postponed

WASHINGTON.—Postponement of the South Amercan Petroleum Congress from the first week in March to the last part of June was announced this week by the U. S. State Department.

The congress is scheduled to be held in Lima, Peru. Decision to postpone the meeting was made by the arrangements committee November 30.



Oil from the flow test on Texas Petroleum Co.'s 1 Velasquez was accompanied by 206,000 cu. ft. of gas. This test is the first drilled on the Teran-Guaguaqui fee property. Drilling started December 8, 1945, and continued into basement rocks at a total depth of 8,455 ft. before testing. (Journal, December 2, p. 64)

A flow test on Texas Petroleum Co.'s 1 Velasquez, located about 90 air-line miles from Colombia's DeMares concession, shows a daily potential of 383 bbl. of 27°-gravity (A.P.I.) crude through a ¼-in. choke from perforations in the casing opening up four sands in the interval 6,945 ft. to 7,120 ft.

WASHINGTON WATCHING

BY HENRY D. RALPH

The "Mother Hubbard" Suit

A DEPARTMENT OF JUSTICE official revealed this week that the antitrust division has recommended dropping the "Mother Hubbard" suit but that the attorney general has not approved the recommendation. However, the recommendation was not definitely rejected and is being further studied and in the meantime the case is being kept on the active docket of the federal District Court and preparations for trial are proceeding.

Earlier, it appeared definite that the case would go to trial. This seemed to be the logical interpretation of the action of the department in asking the court for another 90 days to answer Sun Oil's petition for a bill of particulars.

As recently as 10 days ago top Justice Department officials were seriously considering dropping the 6-year-old omnibus suit. A decision soon was almost imperative, because the department had twice obtained a postponement of the date for answering Sun Oil's interrogatories, and on December 15 the Government had to file an answer, ask the court to deny Sun's request, or abandon the whole case.

Trial Will Be Difficult

The A.P.I. case, a civil action, charges the major oil companies and their subsidiaries with conspiring to fix prices and crowd out independents in all branches of the industry but particularly in marketing. It is so inclusive in scope and so general in language that many lawyers feel trial will be very difficult and involved unless the complaint is amended or bills of particulars supplied as to the specific charges against each defendant. In 1941 a consent decree was almost negotiated, but then the case was postponed for the duration of the war. Again last fall consent-decree negotiations were conducted without results, and the Government asked the court to require the defendants to answer.

In the meantime the Department of Justice has worked up several new complaints against regional groups of oil companies involving allegations of antitrust violations in specific trade practices, such as exclusive-dealer contracts. Some of these have been ready to file for several months but have been held up while top Justice officials pondered substituting them for the A.P.I. case.

However, one or two of these cases probably will be filed very shortly in spite of the apparent decision to go ahead with the Mother Hubbard prosecution.

Relaxed Restrictions on Lead

THE revised lead-conservation order, which presumably will stand until the expiration of the Second War-Powers Act March 31, ends the government set-aside and allocation program but retains all the other controls, including inventory restrictions and end-use quotas.

Formerly 25 per cent of domestic production of metallic lead was set aside as a pool from which the Civilian Production Administration made allocations to certain priority users. Now the entire domestic and imported lead supply is open to purchase by any one but only for permitted uses and only up to the limit of the quarterly quota for each user.

This should permit manufacturers of batteries and tetraethyl lead to obtain their full quotas, something they have been unable to do for several months. The ethyl-fluid quota for the first quarter of 1947 has not yet been set, but may be fixed this week. The fourth-quarter quota for replacement automobile batteries has been raised to 86 per cent of the base period, an increase of about 7 per cent over the quota originally set for the last 3 months of 1946.

Remnants of the Subsidy

RECENT increases in crude-oil prices have wiped out the stripper-well subsidy completely except for about 30 cents per barrel on Pennsylvania-grade crude.

The Reconstruction Finance Corporation has made no announcements of subsidy eliminations because the last formal readjustment of rates made automatic provisions for the subsidy to go down as prices go up. The remnant on Penn grade probably will continue for several months, unless the posted price rises over its top. There is some uncertainty whether Congress made the stripper payments mandatory until June 30 when it extended the Price-Control Act, but RFC will continue payments until given new instructions by what used to be the Office of War Mobilization and Reconversion, now the Office of Temporary Controls. Some time in the future OTC may take a look at the entire subsidy program and issue a directive on stripper-well payments, but no action is expected immediately.

OTC—Final Control Agency

NOW its the OTC—Office of Temporary Controls—the latest and, presumably, the last of the alphabetical emergency agencies.

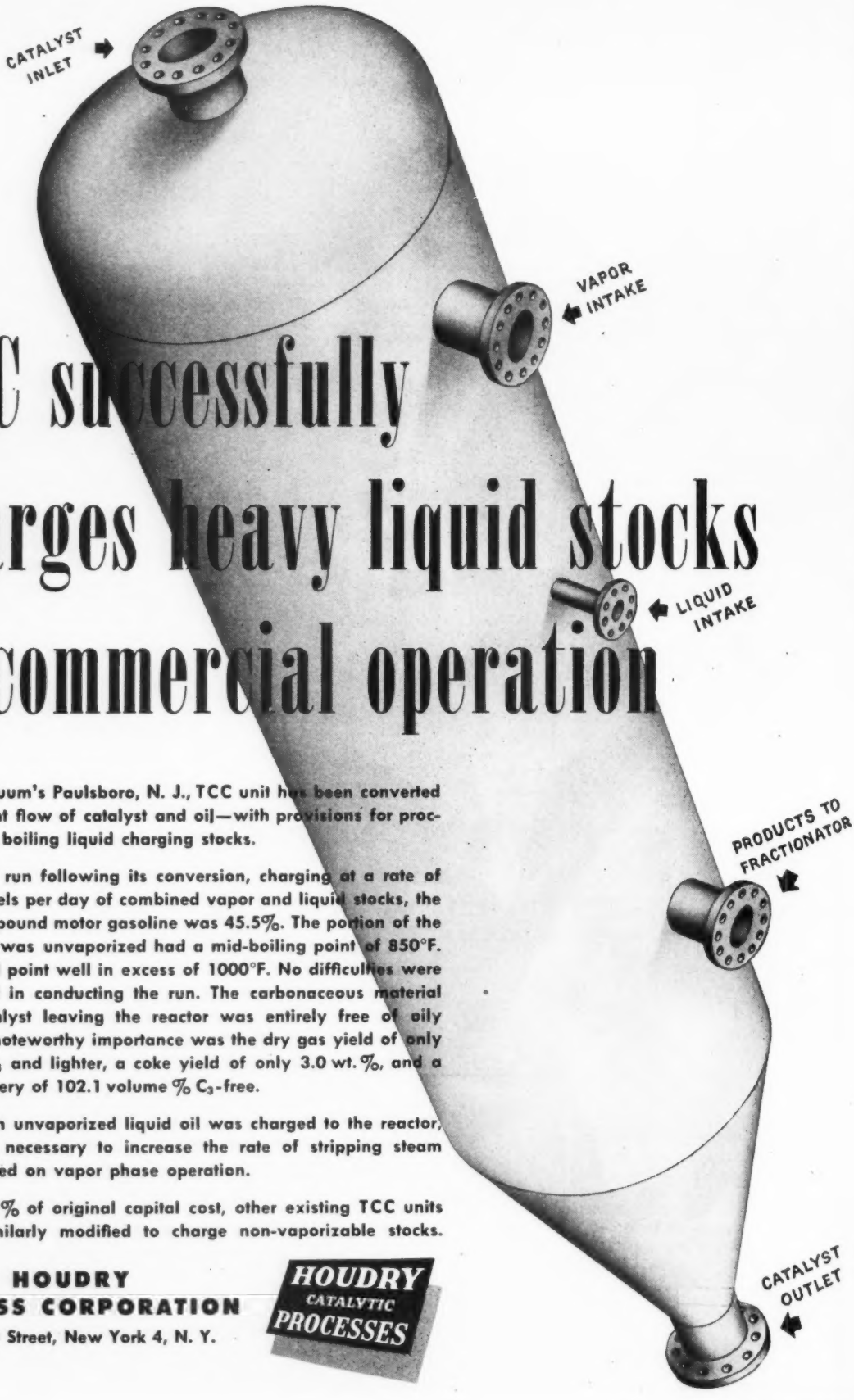
Into it President Truman has dumped the remnants of OPA, CPA, OWMR, and a few other holdovers. Their demise and interment will be a side-line job for Maj. Gen. Philip B. Fleming, the Federal Works Administrator.

OTC is well named, for all the important powers entrusted to it expire by law either March 31 or June 30, 1947. A few war-emergency powers of the president, which may be exercised by OTC, continue until 6 months after the war is officially declared ended, which can be done either by Congress or the president. President Truman said he would have declared the war legally over before this if it were not for strikes and a few other emergency conditions, but Congress is seriously considering making such a declaration. Most of the new Republican majority was all set to "end" the war at the outset of the new session, but those who have looked into the several hundred war powers and the things that have been done with them are cautioning a more deliberate course. It seems that some of the war powers, such as reorganization of the Army, are desirable in peacetime, so Congress will have to pass a series of permanent laws to retain a few of the wartime activities before it will feel free to junk the rest by a blanket resolution.

The very name of the new agency is assurance—if more were needed—that both the administration and Congress are still moving away from a controlled economy and toward free enterprise. It has been quite some time since anybody in the Government has predicted that we will always have price controls and government direction of industry through priorities and allocations.

Another step in this direction was the drastic revision of the Government's housing program, following the resignation of Wilson Wyatt as housing expediter. Industrial and commercial construction are still limited by permit, as they have been during the past year, but there is assurance that such permits will be issued more freely from now on and prospects that restrictions will be removed by spring.

"All Is Calm... All Is Bright"
LARKIN PACKER COMPANY



TCC successfully charges heavy liquid stocks in commercial operation

Socony-Vacuum's Paulsboro, N. J., TCC unit has been converted to concurrent flow of catalyst and oil—with provisions for processing high boiling liquid charging stocks.

On the first run following its conversion, charging at a rate of 10,000 barrels per day of combined vapor and liquid stocks, the yield of 10 pound motor gasoline was 45.5%. The portion of the charge that was unvaporized had a mid-boiling point of 850°F. with an end point well in excess of 1000°F. No difficulties were encountered in conducting the run. The carbonaceous material on the catalyst leaving the reactor was entirely free of oily matter. Of noteworthy importance was the dry gas yield of only 3.9 wt. % C_3 and lighter, a coke yield of only 3.0 wt. %, and a liquid recovery of 102.1 volume % C_3-free.

Even though unvaporized liquid oil was charged to the reactor, it was not necessary to increase the rate of stripping steam formerly used on vapor phase operation.

For about 1% of original capital cost, other existing TCC units can be similarly modified to charge non-vaporizable stocks.

HOUDRY PROCESS CORPORATION
25 Broad Street, New York 4, N. Y.

HOUDRY CATALYTIC PROCESSES

New commission officers for 1947: Warwick M. Downing, Denver, reelected second vice chairman; Hiram M. Dow, attorney of Roswell, N. M., chairman; Clarence T. Smith, attorney and operator of Selma, Ill., first vice chairman

Compact Group Sees 3 Per Cent Oil-Demand Gain in 1947

by George Weber

DALLAS.—Stocks of crude oil and petroleum products, conservation payments for stripper production, and oil imports, as such subjects concern conservation of oil and gas reserves were the principal topics discussed during the closing sessions of the Interstate Oil Compact Commission at its winter quarterly meeting here last week.

A 3 per cent in demand for all oils in 1947 was forecast by members of the economics-advisory committee, reporting on the industry developments for 1946 and the outlook for 1947. This demand, amounting to 5,425,000 bbl. daily was projected on the basis of business conditions generally, disregarding the possibilities of a sharp improvement or a recession during the coming year.

To meet the committee's estimate of demand, it was stated that domestic production averaging 4,655,000 bbl. daily would be sufficient. This production rate is about 90,000 bbl. less than the 1946 daily average, but about the same as current withdrawals. Increased demand will be met largely by net withdrawals from stocks, a slight increase in natural-gasoline production and the continuation of imports at the recent level of 400,000 bbl. daily.

The 1947 forecast followed an intensive survey of this year's developments in the industry. The committee summarized the 1946 record as follows:

1. Demand in 1946 will be about 5,280,000 bbl. daily.

2. Supply in 1946 will be 5,430,000 bbl. daily.

3. Additions to stocks of all oils are estimated to be 150,000 bbl. daily or 54,000,000 bbl. for the year.

4. There has been an expansion of about 5 per cent in exploratory activity in 1946 concurrent with the greater availability of materials and manpower and other economic changes.

The most significant fact revealed by the 1946 survey was that demand has remained within 1 per cent of the wartime peak in 1945, civilian consumption largely offsetting the sharp decline in military requirements. Compared with 1941, this year's demand was 20 per cent higher.

Stocks of gasoline and crude oil remained relatively unchanged during 1946 and the total addition of 54,000,000 bbl. of all oils to stocks during the year was largely the result of the following stock increases; distillate fuel oil, 25,000,000 bbl.; residual fuel oil, 16,000,000 bbl.; and kerosene, 7,000,000 bbl. In comparing the 1946 stock trends with previous years, the committee noted that 1945 showed unusually low stock levels and demand has greatly increased since 1941. Reasonable working stocks are related to the level of operations involved, and must increase as demand does, although the change in stocks is not necessarily in direct proportion to the change in demand, the committee reported. The reversal in seasonal demand also was pointed out, and the group declared it reasonable to expect that in the future normal winter demands may exceed summer demand by more than the 1936-41 average margin of 184,000 bbl. daily.

Committee's Conclusions

The committee concluded:

1. The additions to stocks in 1946 appear to have been more than needed for reasonable operations.

2. The committee estimates that a net withdrawal of 10,000,000 bbl. in 1947 would place total stocks within reasonable levels, but that the draft on product stocks should be larger to allow for some needed additions to crude-oil stocks.

3. The demand in 1947 is expected to be about 140,000 bbl. daily above 1946, but can be met with a new supply about the same as in 1946.

Other developments affecting conservation of oil and gas in this country were considered in an open-forum session on the closing day of the meeting. The issue of conservation payments for stripper production was discussed by proponents and opponents of such payments, but the commission took no definite stand. A resolution adopted without oppostion called for the appointment by the commission chairman of a committee to study the problems of maximum recovery of oil from stripper reserves and to work in cooperation with other organizations conducting similar investigations.

Accepting without opposition the findings of the nominating committee, the commission member elected the following officers for the coming year: Chairman, Hiram M. Dow, attorney, Roswell, N. M., and former lieutenant governor of that state; first vice chairman, Clarence T. Smith, attorney and independent operator of Selma, Ill.; second vice chairman, Warwick M. Downing, Denver; executive secretary, Earl Foster, Oklahoma City. Host city for the next commission meeting will be selected later by the executive committee.

Strong Demand Continuing In Products Markets

CONTINUING strong demand for practically all products, including a heavy offseason movement of motor fuel, characterized petroleum markets early this week.

A number of offers for heavy fuel oil was reported in the Mid-Continent area despite the fact the coal strike has ended. Although residual was going to railroad users at $1.25 per barrel and the posted price was $1.35 to $1.39, spot-market material was said to be moving at $1.40. On the Gulf Coast, residual prices were reported ranging around $1.50 per barrel.

Distillate fuel oils, the industry's usual winter product, also were the subject of active trading with prices firm at existing levels. Mid-Continent market sources said another increase for this group of products, possibly ⅛ cent or even higher, is likely, particularly if demand continues.

A refinery representative pointed out that the three ⅛-cent increases since the 10-cent crude-oil advance do not completely compensate for the higher crude price inasmuch as the burning oils are carrying the entire amount of the advance at this season. One marketer, however, said some buyers, believing that the full amount of the rise has been reached, are slackening off in their purchases.

Gasoline prices were unchanged generally, but suppliers said demand is particularly good for this season. A few scattered price increases for gasoline were reported throughout the country, but the principal quotation remained at 7-7⅛ cents in the Mid-Continent area. Some spot-market material continued to move below this figure.

Export demand was strengthening the gasoline market on the Gulf Coast. Prices for 70-72 octane leaded motor fuel ranged upward from 6¾ cents. Foreign governments as well as U. S. agencies were reported to be buying heavily.

In New York, residual fuel oil was reported tight. No. 2 fuel oil and kerosene prices were firm, and stocks were said to be ample for the present.

Pacific Coast refinery-product markets were steady at unchanged prices and without particular feature. Slack created in export and coastwise markets for drummed products by the maritime strike has been removed. Transfer of out-of-state cars to California operation continues at a pace only slightly lower than prevailed during the summer months. These transfer customers for California gasoline are more than balancing the slight gallonage recession customarily accompanying fall and winter weather.

DEATHS

Calvin Chatman Owens, 55, retired vice president and superintendent of production of Consolidated Oil Co., died December 9 in San Diego. Owens, who retired 6 months ago, had been with Consolidated about 20 years, prior to which he served with The Texas Co.

Charles R. Edwards, 70, president of Houston Engineers, Inc., and an inventor of oil field tools, died December 13 at his home in Houston.

C. H. Leonard, 53, Houston, accountant in the income-tax department and an employe of The Texas Co. 34 years, died December 12 while hunting on a ranch near Uvalde, Tex.

L. B. Ogilvie, chief engineer for Williams Brothers Corp., in Maracaibo, Venezuela, died at his home in Maracaibo December 4, the day following his return from a trip to the United States. Ogilvie had been with the Williams Brothers organizations since he entered their operations in May 1943 when they were engaged in construction of a pipe line for the Navy in Florida.

Bert L. Turner, 73, independent oil operator, died at his home in Houston, December 11.

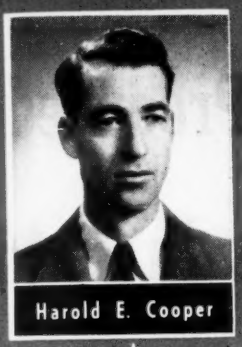
Crude Price Raised in Two California Fields

LOS ANGELES. — A minor regrouping of fields in Kern County on Standard Oil Co. of California's crude-price schedule last week had the net result of lifting postings for Greeley and Wasco fields from 2 to 5 cents per barrel.

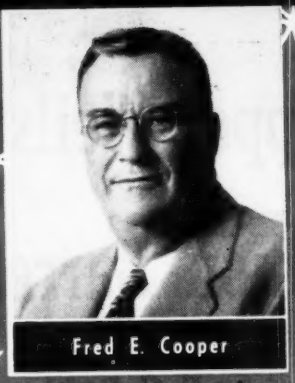
Greeley and Wasco were consolidated with Coles Levee and the Elk Hills Stevens zone in Price Bulletin 113, effective December 6. The new schedule for crudes from these origins now ranges from $1.40 for 30-30.9° gravity to $1.67 for 38-38.9° gravity. The new posting for the four fields, which is the same previously applied only to Coles Levee and Elk Hills Stevens zone is tabulated below. Canal was dropped from the new posting.

Gravity	Current posting for four fields
30-30.9	$1.40
31-31.9	1.44
32-32.9	1.47
33-33.9	1.51
34-34.9	1.54
35-35.9	1.57
36-36.9	1.61
37-37.9	...
38-38.9	...

The New Mexico Oil and Gas Association reelected its officers and members of the executive committee at the organization's recent annual meeting in Artesia, N. M. Front row—Harry Leonard, treasurer; Emery Carper, vice president; Van S. Welch, president; and Jack M. Campbell, executive secretary. Back row—John M. Kelly, J. N. Dunlavey, and Ralph Henrickson. Executive committee members not in the photograph are F. J. Danglade and Niven M. Baird

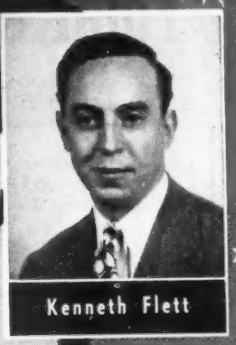


Harold E. Cooper



Fred E. Cooper

J. W. Allen



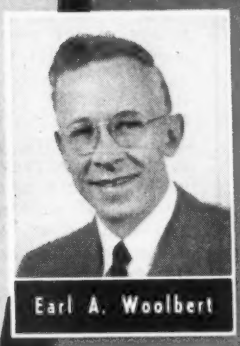
Kenneth Flett

Seasons Greetings

As we end this year of shortages and frustrations, we have a feeling of deep regret that we have failed to serve the industry in the manner, we hope is ordinarily, expected of this organization. It is our hope that the coming year will be one, that will enable all of us to see "a job well done" when it ends.

Fred E. Cooper

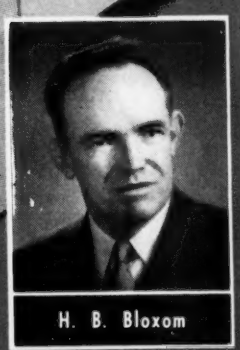
Allis-Chalmers



Earl A. Woolbert

Howard Appleton

Guy E. Reed



H. B. Bloxom

C. F. Nelson

H. R. Kramp

Earl H. Cochran

Total of 299,146 Stripper Wells Produced 230 Million Barrels in 1945

The National Stripper Well Association and the Interstate Oil Compact Commission have completed their fourth survey of stripper wells with data from 22 oil-producing states for 1945. Results of the survey were presented at the commission's recent winter meeting in Dallas by E. G. Dahlgren, assistant secretary of the commission. The survey for 1944 was presented at the winter meeting in Wichita, Kans., in December 1945 (see The Oil and Gas Journal, January 19, 1946, pp. 59-60). As in previous surveys, a stripper well is defined as a well whose production expenses approximate income which permits an uneconomic deep well with substantial production to be classified as a stripper well.

by E. G. Dahlgren

WITH 421,447 producing oil wells in the nation as of January 1, 1946, a total of 299,146 or 71 per cent are classified as stripper wells. The 1945 total exceeded the 1944 total of 296,388 wells by 2,758 wells, but the increase of 8,582 producing oil wells reduced the percentage of stripper wells from 71.8 per cent.

In 1945 these stripper wells produced 230,688,764 bbl. of oil or 13.5 per cent out of a total U. S. production of 1,710,971,000 bbl. The average daily production per well was 11.1 bbl. for all oil wells and 2.1 bbl. for the stripper wells.

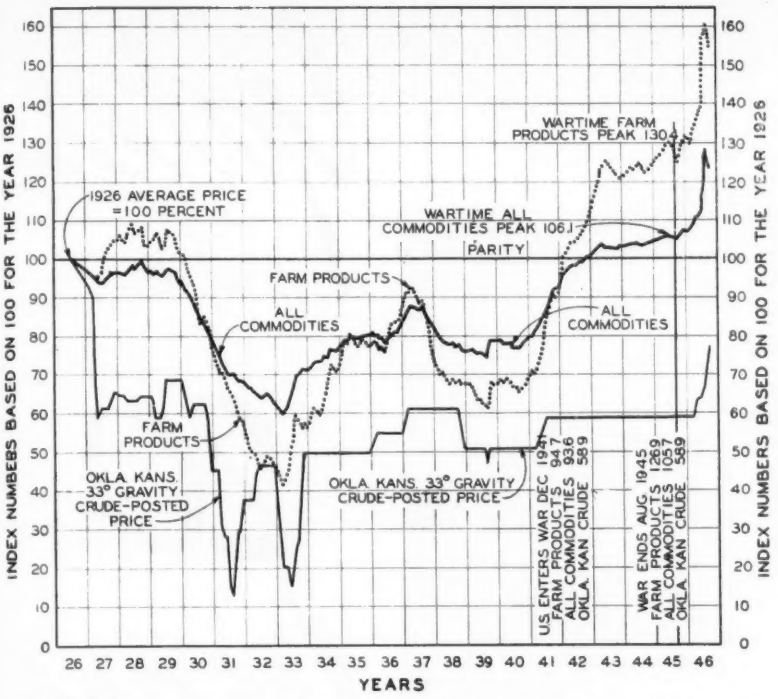
It is interesting to note that the stripper-well acreage of 3,104,410 acres comprises about 46 per cent of the nation's oil acreage of 6,719,891 acres. Producing oil wells abandoned in 1945 were 9,103, a decline of 297 from the 1944 total of 9,400 abandonments. One assumption for the decline in abandonments might be attributed to the federal compensatory payments which enabled stripper wells to maintain operation.

It is estimated that the 9,103 producing oil wells abandoned in 1945 left a total of 18,626,927 bbl. of recoverable oil. The 1945 total exhibits

FACTS AND FIGURES OF THE NATIONAL STRIPPER WELL SURVEY - FOR THE YEAR 1945

States	No. Stripper Wells Producing	Production Of Stripper Wells	Average Price Per Bbl.	Productive Acreage: Stripper Wells	Productive Acreage: All Wells	Oil Well Abandonments: No. Wells 1945	Oil Well Abandonments: Recoverable Oil, Bbl.	Additional Reserves Recoverable From Stripper Wells by Secondary Recovery, with Price Increases Of: 25¢	50¢	75¢
Arkansas.....	2,239	5,846,770	$ 0.95	31,737	69,669	56	100,000	None	None	50,000,000
California....	10,000	29,200,000	1.00	80,000	246,619	307	1,535,000	None	528,000,000	528,000,000
Colorado.....	95	140,660	1.11a	3,140	7,100	None	None	100,000*	200,000*	300,000*
Illinois.....	15,350	6,590,000	1.53b	103,000	245,000	634	634,000	10,000,000	25,000,000	45,000,000
Indiana.....	1,480	444,000	1.70b	8,140*	13,600*	125	165,250*	None*	1,000,000*	1,500,000*
Kansas.....	17,012	29,293,000	1.18a	157,000	255,000	525	1,330,000	50,000,000	65,000,000	155,000,000
Kentucky.....	13,714	4,250,000	1.46	50,000	51,250	200	286,000	10,000,000*	50,000,000*	90,000,000*
Louisiana.....	2,811	7,863,192	1.13a	19,677	255,500	250*	812,500*	1,100,000*	40,000,000*	85,000,000*
Michigan.....	2,941	6,445,247	1.405a	36,055	52,135	164	82,500	None	None	None
Mississippi...	52	234,928	1.01	2,080	21,000	26	200,000	400,000	500,000	575,000
Missouri.....	43	37,715	1.08	480	480	None	None	10,000	20,000	40,000
Montana.....	1,985	2,659,709	1.19a	25,525	45,467	55	39,157	Trivial	1,854,241	3,751,169
Nebraska.....	70	305,000	1.20b	1,360	1,360	3	1,500	None	None	None
New Mexico....	1,100*	2,400,000*	1.04	42,020*	173,940*	2*	2,920*	5,000,000*	10,000,000*	20,000,000*
New York.....	21,300	4,527,852	3.75b	71,000	71,000	424	None	None	None	None
Ohio.....	22,247	2,054,408	1.82a	819,832	839,832	471	700,000	2,000,000	7,500,000	20,000,000
Oklahoma.....	49,124	71,168,080	1.37b	750,000	850,000	735	1,837,500	60,000,000*	100,000,000*	185,000,000*
Pennsylvania..	83,000	12,515,000	3.66b	500,000	500,000	2,500	1,000,000	50,000,000	100,000,000	150,000,000
Tennessee.....	19	6,662	1.53	129	129	1	600	None	None	None
Texas.....	35,000*	38,225,000*	1.18a	262,500*	2,805,570	2,515	9,000,000*	125,000,000*	250,000,000*	375,000,000*
West Virginia.	17,280	2,879,000	3.44b	138,240	138,240	104	832,000	20,000,000	50,000,000	100,000,000
Wyoming.....	1,984	3,602,541	0.92	42,435	79,000	5	50,000	1,559,050	6,592,000	16,111,500
Totals United States	299,146	230,688,764	-----	3,104,410	6,719,891	9,103	18,626,927	335,169,050	1,256,666,241	1,825,277,669

* Unofficial estimate a Does not include subsidy payments b Includes subsidy payments



Price-index chart—comparison of index numbers of wholesale prices of all commodities, farm products, and posted prices of crude petroleum, Oklahoma-Kansas, 33° gravity. (Year 1926 = 100 or parity.) Chart prepared by Interstate Oil Compact Commission and National Stripper Well Association

a favorable trend from previous years when 34,000,000 bbl. were left in 1944 and 44,000,000 bbl. in 1942.

Interesting data included in the summary are the estimated additional reserves which may be recovered from stripper wells by secondary recovery methods with price increases of 25 cents, 50 cents, and 75 cents per barrel.

Following are the estimates for the United States:

Increase of 25 cents per barrel: 335,169,050 bbl.

Increase of 50 cents per barrel: 1,255,666,241 bbl.

Increase of 75 cents per barrel: 1,825,277,669 bbl.

It is generally conceded that there is at least 3,000,000,000 bbl. of oil reserves that can only be produced by secondary-recovery methods. It is also recognized that present primary and secondary-recovery methods produce not over 50 per cent of our reserves. Additional price increases and more secondary-recovery research are necessary to recover the major portion of these reserves.

The accompanying price-index chart shows that the all-commodities index reached the peak of 129.1 in August 1946, while the farm-products index soared to its peak of 161. However, in September the all-commodities index dropped to 124 and the farm-products index dropped to 154.3. The index of Oklahoma-Kansas crude oil did not participate in the general rise as it was frozen at 58.9 in late 1941 and was not permitted to rise by the Office of Price Administration until April 1946 when the index rose to 63.2. In May the index rose another point, while in June the index rose to 66.9. The latest data available show the index at 77.5, the highest it has been since the early part of 1927. The recent price increase of 10 cents per barrel in November will raise the index to 82.8.

The following table shows a compilation of indexes and prices for Oklahoma-Kansas crude oil with hypothetical increases. In order to reach an index of 100 as in 1926, it will be necessary for crude prices to advance an additional 32 cents per barrel.

Price, Oklahoma-Kansas crude, 33° gravity:

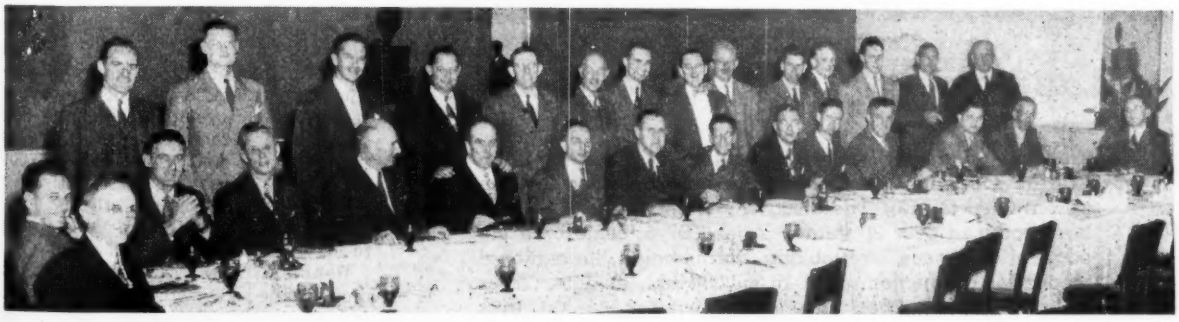
		Price index
$1.46	Posted price, Sept. 1946	77.5
1.51	(5 cents increase)	80.1
1.56	(10 cents increase)	82.8
1.61	(15 cents increase)	85.4
1.66	(20 cents increase)	88.1
1.71	(25 cents increase)	90.7
1.76	(30 cents increase)	93.4
1.81	(35 cents increase)	96.0
1.86	(40 cents increase)	98.7
1.88	(42 cents increase) or parity	100.0

Jersey Standard Will Open Marine Terminal

PAULSBORO, N. J.—A new terminal for supplying bunker fuel oil to the marine trade will be opened by Standard Oil Co. of New Jersey here January 1. The terminal is being located at the Patterson oil terminals adjacent to the Mantua Creek anchorage basin on the Delaware River.

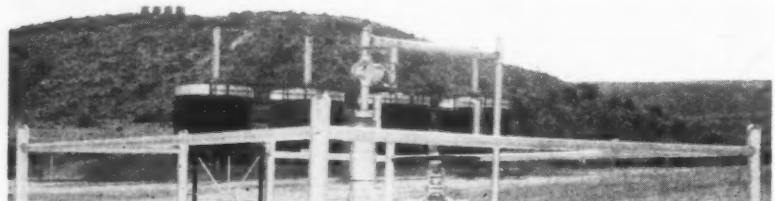
W. E. Black, division manager, said the installation, which will have a water depth of 32 ft. at mean low tide, will accommodate ocean-going ships and will provide 24-hour bunkering service for all sizes of vessels, including complete barging service.

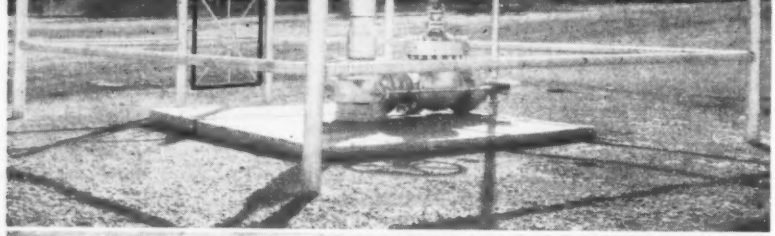
JOURNAL EDITORS HOLD CONFERENCE



Engineering members of the editorial staff of The Oil and Gas Journal and Petroleo Interamericano met in Tulsa last week to plan the program of engineering and operating material to be published during 1947. This editorial group, together with representatives of other departments of the Petroleum Publishing Co., is shown above at a dinner meeting held at the Tulsa Club December 12

Famous Trio of Wells





Have Records to Their Credit

This trio of famous wells was drilled at Yates by Mid-Kansas Oil and Gas Co. and is now operated by the parent Ohio Oil Co. The discovery well, Yates "A" 1 (top) has produced over 20 years. Yates "D" 5 (center), on the edge of the mesa overlooking Iraan, holds the national record for production, over 10,350,000 bbl. to date. Yates "A" 30 (bottom) when completed flowed 8,524 bbl. in 1 hour through the casing and several lines to storage, with some back pressure. All three wells are still flowing.

Yates after 20 Years

by George Weber

ONE of the nation's most prolific oil reserves, the Yates pool of West Texas, recently passed the twentieth anniversary of its discovery. In early September 1926, Mid-Kansas Oil & Gas Co. moved a cable-tool rig into the remote rugged terrain of the Yates ranch near the bend of the Pecos River and spudded in an arroyo eroded from the Cretaceous limestone mesas. About a month later the bit encountered the top of the Yates brown lime at 990 ft., and soon after, on October 29, shows of oil halted drilling at 1,004 ft. After an initial gage of 75 bbl. of 30° gravity oil daily, the well was successively deepened, showing increasing productivity. The following summer it was completed at 1,150 ft. for an initial flow of about 3,000 bbl. per hour.

The prospect of great potential production at shallow depth brought rapid field development. Cable-tool completions reached a peak of 175 in 1928 and soon after the 20,000 productive acres of the pool were fairly well defined; outlining the greatest strike in the Permian basin to date.

Ranking sixth in estimated ultimate recoverable reserves, the field has produced over 320 million barrels of oil in the past 20 years, a record exceeded by only 12 other domestic fields to date. With the exception of

. . . This famous pool has produced 320,000,000 barrels of oil and 90 per cent of its wells are still flowing

East Texas and Conroe, both discovered since Yates, all such fields are well into the declining stages of their production histories. Yates not only shows promise of future recovery equaling that of the past 20 years, but it is given a maximum efficiency rate of production exceeding current withdrawals by 20 per cent. Not since 1933 has the field produced an average of 50,000 bbl. daily, the new MER figure accepted by the Texas Railroad Commission.

Production at Yates has been restricted to some degree since its discovery. First, pipe-line capacity and later, market demand and state proration have exerted controls on the field's output. Excepting for two 40-million-barrel years, (1929, 1930) withdrawals have amounted to only a fraction of the field's potential. Such restriction has spared the field the excessive development and exploitation which damaged many other early fields. It also led operators to agree on voluntary allocation of production within the pool. The cooperative efforts of engineers in studying the reservoir and determining equitable allowables have formed the basis for many proration principles in common use today.

The pool is famed for its phenomenal producing capacity. Shallow wells, costing originally $15,000 to $30,000, include two holding national records. Both were drilled by Mid-Kansas Oil & Gas Co. and are now operated by the parent Ohio Oil Co. The Yates "A" 30 gaged 8,524 bbl. in 1 hour on its initial potential test. Had more lead lines and storage been available, engineers estimate the well would have flowed over 10,000 bbl. an hour. The field's per well production record is held by the Yates "D" 5 which has produced over 10,350,000 bbl. and is still flowing. This record is believed exceeded in this hemisphere only by wells in Tampico's Golden Lane.

Yates is better known in engineering circles for the work of the Yates Pool Engineering Committee, forerunner of many such committees. Under the direction of the Yates Pool Advisory Committee, the engineer group planned and completed the first field-wide reservoir pressure survey on record and initiated many practices which find general use in the industry today. As a result of early application of sound engineering practices, Yates produces small quantities of gas and water. Its pressure-production relationship is remarkable; over the 20-year period the recovery of oil per pound drop in reservoir pressure has averaged 1.6 million barrels and since 1935 the average is nearly 6.5 million barrels.

Proration History

Faced almost from the first with restriction of production, operators at Yates realized that an equitable proration plan within the field was necessary. The first such plan, adopted voluntarily by all operators in Octo-

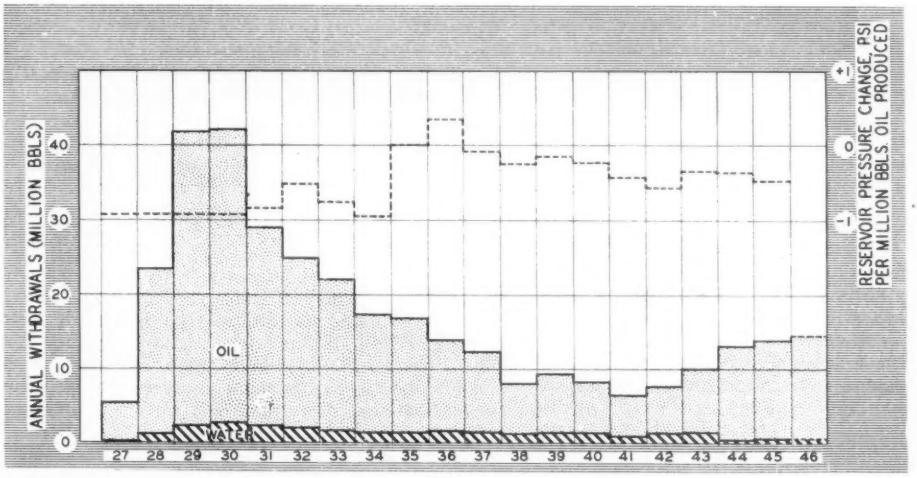


Chart showing production history of Yates pool

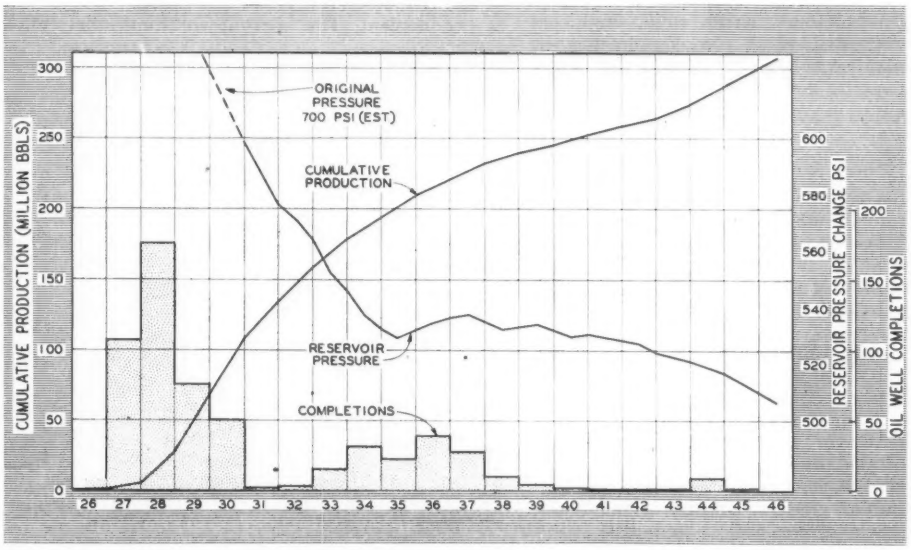


Chart showing pressure-production data of Yates pool

ber 1927, allocated well production on a straight open-flow potential basis. The principal flaw in this plan lay in the premium it placed on intensive drilling in the cavernous, high-potential sections of the field. Heavy withdrawals from such locations resulted in rapid pressure drops, excessive gas-oil ratios, and accelerated water intrusion.

In January 1928 operators adopted a proration plan placing well allowables on a straight acreage basis. However, the practice of allowing large wells to produce small wells' allowables largely nullified the effect of the acreage factor. This plan was shortly dropped and engineers drew on their experience with the two plans to devise a third, incorporating potential as a governing factor and acreage as a modifying factor. This third plan was made effective in July 1928 by voluntary agreement among operators. The field was divided into 100-acre production units. Allowables per unit were weighted 75 per cent on potential and 25 per cent on acreage. At the invitation of operators, the Texas Railroad Commission made the plan effective by an order, later requiring that each well produce its own allowable. This resulted in more uniform withdrawals over the field and further reservoir damage in the heavy production areas was averted.

Meanwhile, the engineering committee, formed in 1927, was studying plans for replacing the unsatisfactory open-flow-potential tests with a better method for measuring well capacity to produce. Potential tests conducted twice yearly required expensive field storage and were causing premature water production in some wells. Well-performance studies were made in an effort to arrive at potential open flow from pressure and production data observed at various restricted flow rates. After trying this method in the field, engineers discarded it as too complicated. A plan was then devised, adjusting existing potentials in ratio of the decline in reservoir pressure at each well. The first field-wide reservoir pressure survey was completed late in 1930 and in June 1931 the committee recommended the substitution of semiannual pressure surveys for potential tests. The new method was adopted the following month. Early surveys covered all wells into which pressure bombs could be run, but later 317 key wells were selected, whose bottom-hole pressures arithmetically averaged, proved representative of true field-wide conditions. Pressure readings were originally taken at fixed depths below the top of the brown lime, a marker occurring just above the gray lime production. A standard datum plane above sea level was later adopted.

Early pressure surveys of course permitted early studies of reservoir performance in the field. The presence of a water drive was proven by intermittent pressure increases from July 1935 to July 1942. From the pressure-production relationship in the field, engineers conclude that although solution gas and gas caps exert the principal reservoir energy, there exists a water drive of limited nature. Withdrawals exceeding water incursion into the reservoir have created a lag in water drive, accounting for erratic pressure fluctuations.

Since gas provides the principal energy source in the reservoir, engineers focused their attention on its conservation before such a principle was fully recognized in many fields. At the estimated original pressure of 700 psi., all gas was believed to be in solution in the ratio of 165 cu. ft. per barrel. Gas caps formed rapidly during the heavy withdrawals of 1928-30. At present three major gas caps and several minor ones cover the areas of greatest production. Realizing the direct relation between gas conservation and ultimate oil recovery, the engineers committee recommended remedial work on high-ratio wells in early 1931. A voluntary program of deepening such wells to maintain effective tubing submergence prevented further gas breakthrough in most of the worst wells. In 1931 and 1932 gas production was cut from about 34 to about 20 million cubic feet daily. Further reduction of gas-oil ratios resulted from selective acidizing, repairing of leaks in surface connections and tubing strings, and installing bottom-hole chokes. This consistent remedial work brought the field ratio from an average estimated at more than 600 cu. ft. per barrel in 1931 to about 215 cu. ft. per barrel in January 1935. Regular quarterly gas-oil ratio surveys conducted since the first one in January 1934 show that the field has continued to average about 200 cu. ft. per barrel to the present. The current solution ratio at a reservoir of about 505 psi. is estimated at 117 cu. ft. per barrel.

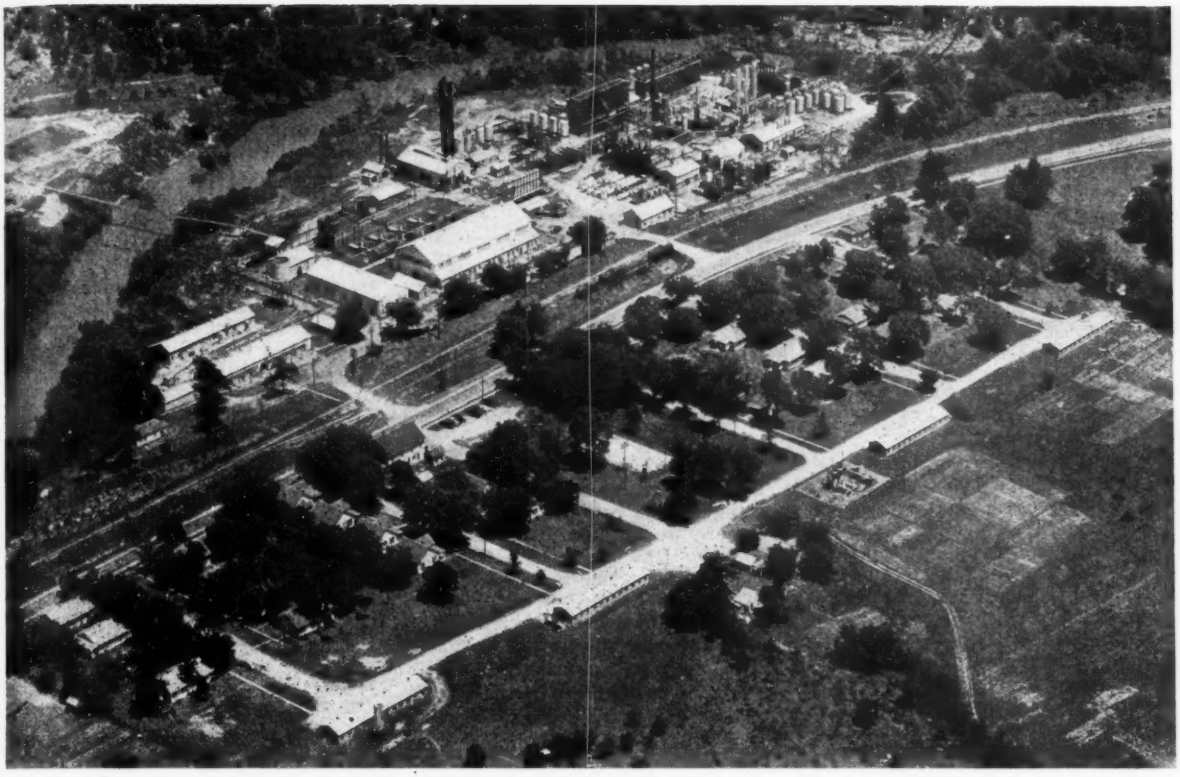
Gas-oil ratio surveys have allowed engineers to study the effect of withdrawal rates on such ratios. They have found that ratios vary inversely with oil production rates within reasonable limits. Since the field has been granted an increased allowable recently, and now produces on the average of 43,400 bbl. daily, the ratio has dropped below 200 cu. ft. per bbl.

Drilling methods have also been studied by the engineers committee. It is possible that many additional wells may be drilled to increase ultimate recovery as reservoir pressure declines. Such wells will be drilled into the pay under closed pressure control with rotary rigs in areas where they penetrate gas caps. Low gas-oil contacts in many wells will require their deepening below the limit of 225 ft. below the top of the brown lime to continue oil production.

Water withdrawals have been so closely watched by the committee that water production has never exceeded 10,000 bbl. daily. The limited penetration of 225 ft. which operators voluntarily follow is largely responsible for maintaining low water withdrawals. Nearly all wells making water lie on the flanks of the structure. To date a total of 75 wells have been plugged back to shut off bottom water and 12 wells which could no longer be improved by plugging back have been shut in and abandoned by operators to conserve the limited water drive in the field.

As a result of well-engineered production, Yates not only promises a great recoverable reserve, but has the ability to produce at a high rate without waste. Flowing life of the pool is expected to continue for years. At present only 10 per cent of the 570 producers in the field are on artificial lift and several wells on the pump require only agitation to flow their allowables.

Surface topography in the Yates pool is extremely rugged; elevations range from 2,146 to 2,960 ft. above sea level



From methane, ethane, and propane this Cities Service Oil Co. plant at Tallant, Okla., manufactures a number of specification products by oxidation processes. (Aerial photograph by Aerial Photo Service, Tulsa)

Basic Oxygenated Chemicals From C_1, C_2, and C_3 Paraffins and Olefins

by John C. Walker* and Howard L. Malakoff†

TO date, there have been four major approaches in the production of oxygenated hydrocarbons. They are: (1) Direct oxidation, (2) dehydrogenation followed by oxidation or hydration, (3) oxidation to carbon monoxide and hydrogen followed by hydrogenation of the carbon monoxide, and (4) chlorination followed by hydrolysis. (See Fig. 1.) Several products to be discussed are now commercially manufactured by two or more of these schemes, economically competing with each other. Most chemicals, however, are presently produced by only one of these methods.

Cities Service Oil Co. has been the pioneer in the direct oxidation of the

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TABLE 1—THE DIFFERENT GROUPS OF OXYGENATED-TYPE CHEMICALS, WITH NAME AND FORMULA OF ONE COMMON MEMBER OF EACH

Type compound—	Functional group	Typical compound	Formula
1. Alcohol	—OH	Methanol	CH_3OH
2. Acid	—COOH	Acetic acid	CH_3COOH
3. Anhydride	$-C(=O)>O$ $-C=O$	Acetic anhydride	$CH_3C(=O)>O$ $CH_3C=O$
4. Aldehyde	$-C(H)=O$	Formaldehyde	HCHO
5. Ether	—C—O—C—	Ethyl ether	$CH_3CH_2OCH_2CH_3$
6. Ketone	$-C(=O)-C-$	Acetone	CH_3COCH_3
7. Glycol	$-C(OH)-C(OH)-$	Ethylene glycol	CH_2OH CH_2OH

TABLE 2—PRODUCTION AND MARKET DATA FOR 1945 (FROM U. S. TARIFF COMMISSION)

Chemical—	Production (lb.)	Sales	
		Pounds	Unit value ($/lb.)
1. Acetaldehyde	.....	10,471,000	0.07
2. Acetic acid-synthetic (100 per cent)	267,518,000	97,558,000	0.07
3. Acetic anhydride—from all sources	524,748,000	.....	....
4. Acetone:			
By fermentation	42,417,000	42,498,000	0.07
From isopropyl alcohol	307,363,000	.....	....
5. Butyl alcohol (n-propylcarbinol) (100 per cent)	129,364,000	.....	....
6. Ethylene glycol	205,087,000	.....	....
7. Ethyl ether, all grades	76,598,000	.....	....
8. Formaldehyde (37 per cent HCHO by wt.)	509,602,000	282,051,000	0.03
9. Isopropyl alcohol	490,997,000	272,104,000	0.05
10. Methanol, synthetic	493,110,000	344,911,000	0.03
11. Ethyl alcohol, undenatured (1943) (wine gals.—190 proof)	272,000,000	.....	....

lower paraffin hydrocarbons to valuable oxygenated chemicals. J. C. Walker, one of the authors of this paper, and his associates discovered in 1925 that the corrosion of pipe lines caused by gas containing free oxygen could be minimized by bringing the gas to the necessary temperature and pressure to permit the oxygen present to be completely used up by reacting with the hydrocarbons. The formation of liquid oxygenated chemicals accompanied this reaction. The first commercial plant using an oxidation process of this type was constructed at Tallant, Okla., in 1926. This plant has been expanded and three additional oxidation plants have been built. A modern chemicals refinery has been erected at Tallant to produce commercial-specification products from the crude-oxidation products.

Methane, ethane, propane, and butane are the principal raw materials for this process. A typical oxygenated crude liquid mixture will contain 35 per cent methanol, 20 per cent formaldehyde, and 5 per cent acetaldehyde as principal products. Acetone and dimethyl acetal are also present in recoverable quantities. Water and higher alcohols are the principal impurities. The unit operations of fractionation, liquid-liquid extraction, vacuum distillation, filtration, adsorption, and ion exchange are all involved in processing the original crude chemical mixture to finished marketable products. Heat transmission and fluid flow are of course also involved.

The Cities Service direct oxidation process has made some noteworthy contributions in the chemical field. To the unit process of oxidation it has helped to correct the erroneous impression still taught by some of our organic textbooks, as to the inertness and chemical stability of the paraffin hydrocarbons. In the field of unit operations, its refining process included the first commercial application of ion exchange other than in the field of water purification. To meet the rigid demands of the resin and plastics industries for low acidity formaldehyde, an ion-exchange processing scheme was successfully employed. A number of patents have been issued to J. C. Walker, covering the oxidation of the lower paraffin hydrocarbons.

More recently, Celanese Corp. of America has built a chemical plant near Bishop, Tex., to produce (by direct oxidation of hydrocarbons, reportedly propane and butane) methanol, acetone, acetic acid, formaldehyde. The research organizations of several oil companies are known to be investigating oxidation of the gaseous hydrocarbons.

Ethylene oxide, produced by the

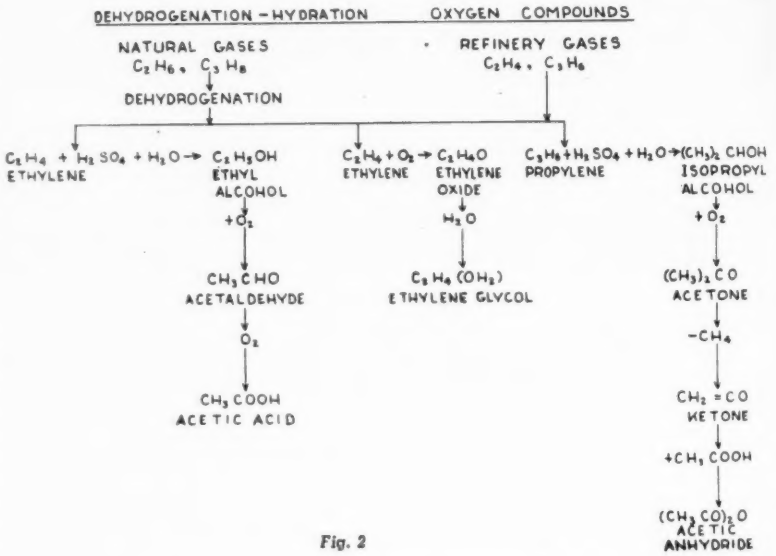


Fig. 2

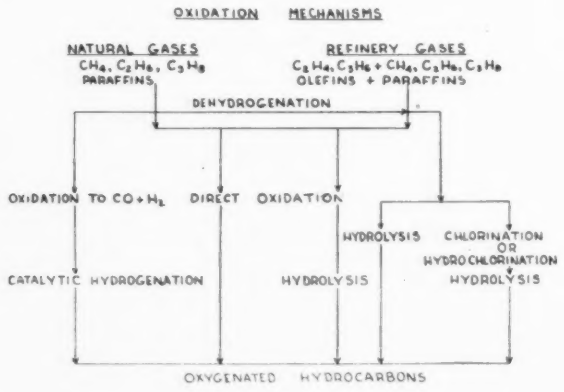


Fig. 1

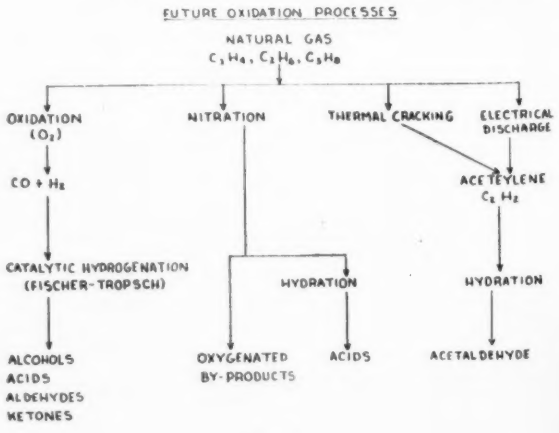
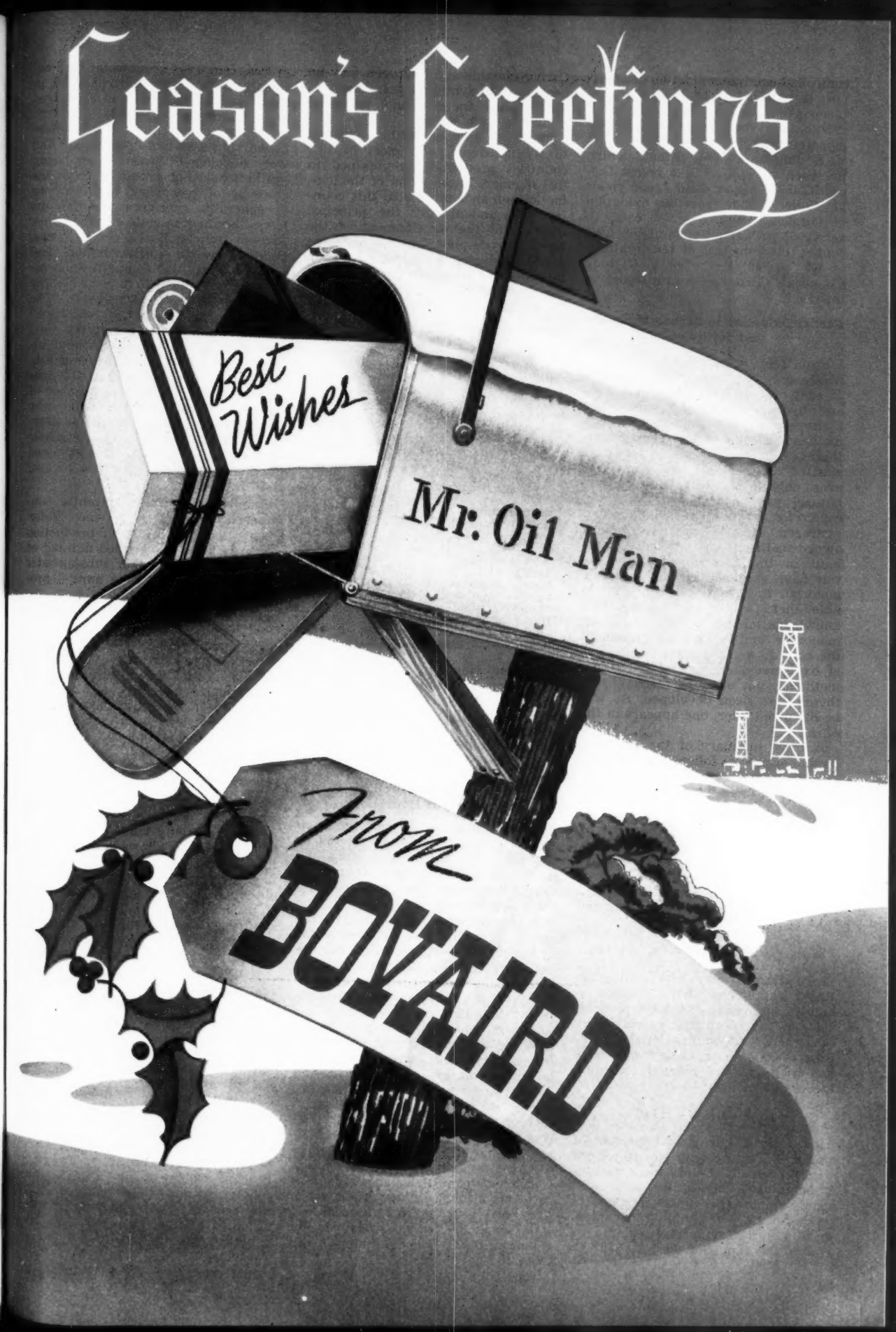


Fig. 3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controlled catalytic oxidation of ethylene, is reported to be gradually displacing ethylene chlorohydrin as a raw material for synthesis of ethylene glycol and its derivatives. The Lefort U. S. Reissue 20, 370 patent,[3] which has been the subject of a recent District Court decision, claims good yields of ethylene oxide from the oxidation of ethylene, using a silver catalyst, activated with small amounts of gold, copper, or iron, and at temperatures of 300° to 700° F. Carbon & Carbide Chemicals Corp. has been a leader in this field.

Partial Oxidation to Carbon Monoxide and Hydrogen

From a historical viewpoint, industrially speaking, the partial oxidation of coal or coke to carbon monoxide and hydrogen, and the subsequent hydrogenation of carbon monoxide to methanol, is one of the earliest syntheses for the production of oxygenated chemicals. It has been, however, only in the last 10 years that natural gas has been used as the source for both carbon monoxide and hydrogen. Most of the government-owned methanol and ammonia plants built in the Southwest during the war have used natural gas as a raw material. It is perhaps surprising to note that despite the accumulated knowledge on the reaction of carbon monoxide and hydrogen throughout the past 25 years for the production of oxygenated chemicals, other than methanol no other industrial syntheses have been developed. As will be discussed later, one appears in the offing.

A brief summary of the synthetic methanol process follows: Natural gas is reacted with steam in the so-called reforming processing according to the reaction:

$$CH_4 + H_2O = CO + 3H_2$$

However, since a 2 to 1 ratio of hydrogen to carbon monoxide is desired for the methanol synthesis, carbon dioxide is added to the reactants and the net reaction is:

$$3CH_4 + CO_2 + 2H_2O = 4CO + 8H_2$$

There are other ways of adjusting the H_2:CO ratio. The above reaction is highly exothermic and takes place at 750°-900° C., requiring special alloy equipment and is considered an expensive installation. Carbon monoxide and hydrogen are reacted according to the equation:

$$CO + 2H_2 = CH_3OH$$

This is one of the most important of the high-pressure syntheses in use today, a pressure of 4,500 psi. commonly being used. The catalyst most commonly employed is copper mixed with oxides of zinc, chromium, manganese, or aluminum. Temperatures employed are in the range of 300° to 350° C. Carbon dioxide and hydrogen may be used for the synthesis gas; however, in that case the methanol produced is diluted with water.

Methanol may be further oxidized to formaldehyde, and most of this country's production is obtained in this manner. Introduction of the synthetic methanol process in this country was undoubtedly the principal impetus to the development of the formaldehyde-phenol or bakelite-type plastics industry. Formaldehyde is an intermediate of great importance in the chemical industry as indicated by Table 3.[3]

TABLE 3—CONSUMPTION OF FORMALDEHYDE
(Thousands of pounds, 37 per cent)

Use—	Amount	Per cent
Total consumption	485,292	100.0
Resins, total	243,375	50.3
Phenolic	137,932	28.4
Urea and melamine	101,048	21.0
Other resins	4,385	0.9
Chemical, total	199,409	41.0
Hexamethylenetetramine	64,407	13.3
Pentaerythritol	55,367	11.4
Rubber chemicals	2,537	0.5
Other chemicals	77,098	15.8
Other uses	33,653	6.9
Textiles	7,998	1.7
Dyes and intermediates	3,498	0.7
Leather	2,640	0.5
Embalming fluid	1,148	0.2
Drugs and pharmaceuticals	804	0.2
Miscellaneous uses	15,392	3.2

Du Pont, Heyden Chemical Co., and Commercial Solvents have been the principal producers of formaldehyde from methanol to date. Casein Corp. recently completed construction of a methanol-conversion plant on the West Coast.

Dehydrogenation Followed by Oxidation and/or Hydration

Fig. 2 is a graphical representation of the basic oxygenated chemicals produced by the above oxidative mechanisms. The largest volume of oxygen-chemicals are produced by these procedures.

Production of ethyl alcohol by the hydration mechanism indicated within Fig. 2, has been described for the Standard Alcohol Co. Baton Rouge plant which commenced operating in March 1943. Ethylene from the adjacent Standard of New Jersey refinery is "cleaned" and goes to an absorber where it is reacted upon by the sulfuric acid, with the formation of a mixture of monoethyl and diethyl sulfates. The liquid discharge stream or mixed esters are pumped to a hydrolyzer where they are decomposed into ethyl alcohol and diethyl ether. This mixture passes to a stripping still where the acid is separated from the vaporized mixture of alcohol, ether, and water. After any acid carryover is removed in a scrubber, ether is removed by steam stripping. The final step in the process removes excess water by fractionation. The sulfuric acid used in absorbing the ethylene is recovered and concentrated for reuse.

Despite competition from established fermentation processes, and war developed "waste" processes, synthetic alcohol produced from the cracking of petroleum hydrocarbons is generally considered to be the lowest-production-cost ethyl alcohol. Alcohol from molasses, cereal grains, potatoes, waste sulfite liquor, and wood wastes, the competitive processes, do not appear to have as healthy an economic future. Tousley in "The Economics of Industrial Alcohol"[4] states: "It is doubtful that the total cost of pure ethylene to synthetic alcohol producers is even now much in excess of 3 cents per pound, (all costs included) and there are a number of people in the chemical industry who believe the postwar cost will be nearer 2 cents." With ethylene available at 2 cents per pound, the estimated maximum cost for synthetic alcohol is 10 cents per gallon.

Standard Alcohol's recently announced expansion of the Baton Rouge plant to bring its production capacity up an undisclosed number of million gallons per year substantiates the economic trend. The annual production of ethyl alcohol in 1940, the last prewar year, was 126 million wine gallons.[5]

The introduction of an ion-exchange process in the sugar-refining industry which appreciably reduces the amount of byproduct sugar syrups or molasses is a factor of interest in the synthetic-alcohol industry. A recent announcement along this line was made by Chemical Process Co.[6]

Competitive Advantages

In spite of the apparent competitive advantages of the ethylene method, it is undoubtedly true that the market will not be allowed to pass from the old time "conventional" producers to this comparatively new competitor without a hard struggle. In addition, a variation of the Fischer-Tropsch synthesis which will be discussed later, is a potential competing hydrocarbon process to be reckoned with.

It is interesting to note in passing that acetaldehyde and acetic acid, the latter one of our large-volume synthetics, are being produced commercially from ethanol by further oxidation steps. The market for acetaldehyde will undoubtedly expand with the increasing interest in pentaerythritol (a condensation product of formaldehyde and acetaldehyde) in the synthetic resin field.

Referring again to Fig. 2, it can be stated that the chemistry and engineering of preparing isopropyl alcohol from propylene follows closely the previously discussed production of ethyl alcohol from ethylene and so will not be further discussed here.

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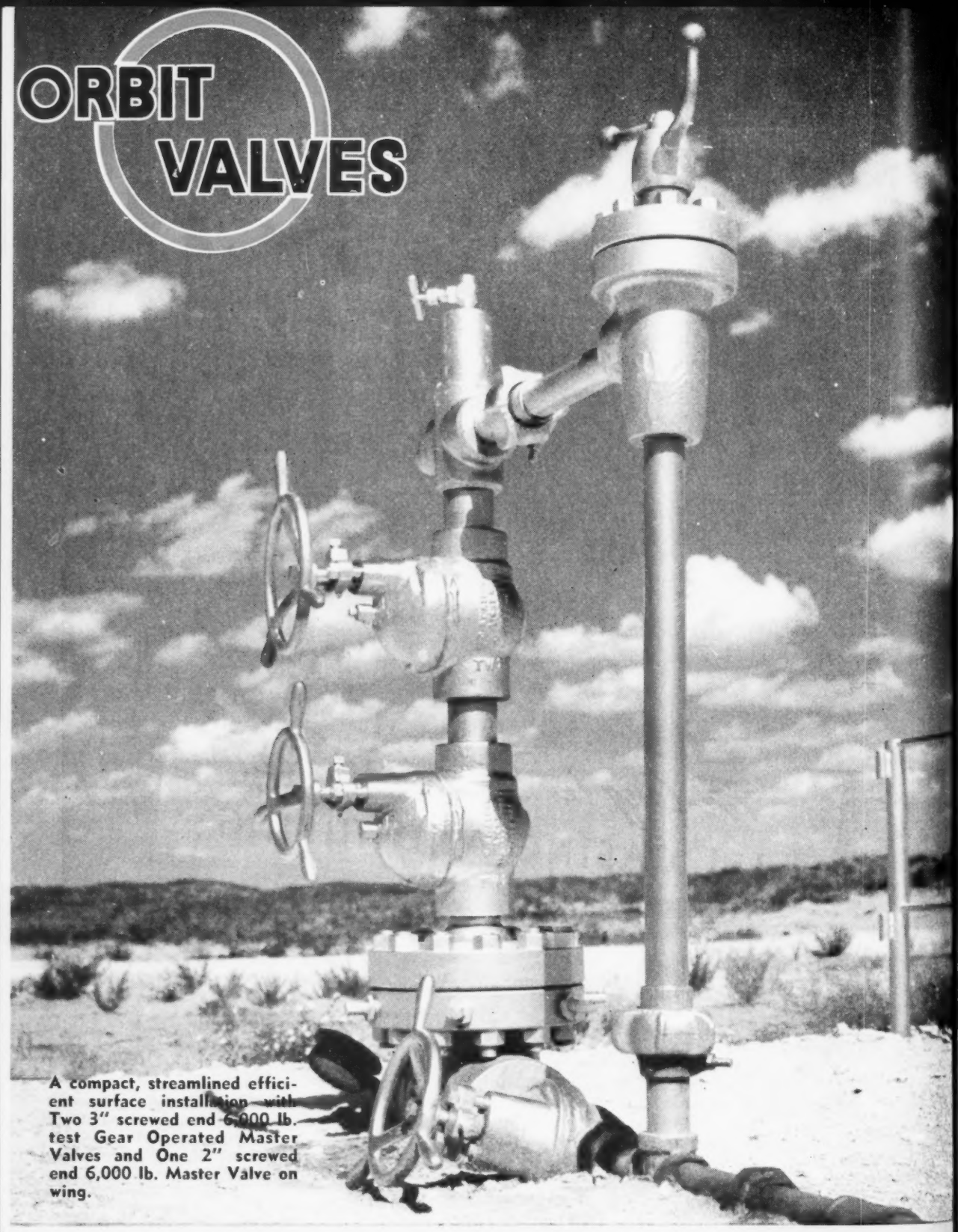

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Most of the country's isopropyl alcohol is converted into acetone by oxidative dehydrogenation. The U. S. Tariff Commission's 1945 production figures show 307,363,000 lb. of acetone produced from isopropyl alcohol compared with 42,417,000 obtained by fermentation processes.

Acetic anhydride, the production of which from all sources was 524,748,000 lb. in 1945, is now being commercially produced through the thermal decomposition of acetone to ketone and reaction of ketone with acetic acid. The volume consumption of acetic anhydride is in the plastics and synthetic-fiber industries.

The production of ethylene oxide from ethylene was discussed with the direct oxidation processes. The hydration of ethylene oxide yields ethylene glycol, the largest single outlet for which is the antifreeze market. There were 205,087,000 lb. of ethylene glycol produced in 1945 from all processes. Initial patent control of this process was held by Carbon & Carbide but the recent District Court decision, previously referred to, and the termination of the basic patents will undoubtedly lead to opening up this field.

Chlorination Followed by Hydrolysis

Production on an industrial scale of a basic oxygenated hydrocarbon through the chlorination route is a recent development. Shell Development Co. in 1941 publicly reported[7] the results of work initiated in 1936 on the production of synthetic glycerol from propylene. Production of allyl chloride by the chlorination of propylene, and the hydrolysis of allyl chloride to allyl alcohol were intermediate steps in this synthesis. As yet no synthetic glycerol plant has been built, but Shell Chemical Co. completed recently at Houston a plant for the production of allyl chloride and allyl alcohol. Additions to this plant have been more recently announced. Allyl alcohol is the basic ingredient of a new group of resins and plastics.

Future Oxidation Processes

Well along in the pilot-plant stage are several oxidation processes which should receive their industrial christening within the next 5 years. Fig. 3 shows several of these processes, classified according to the oxidative mechanisms discussed.

Activities of numerous oil companies in the field of the conversion of natural gas to liquid hydrocarbons through adaptations of the Fischer-Tropsch synthesis has received considerable interest in the past few years. The M. W. Kellogg Co.[8] and Hydrocarbon Research, Inc.,[9] have both announced the production of "byproduct" oxygenated chemicals accompanying the synthesis of high-octane gasoline and diesel-oil fractions.

P. C. Keith, of Hydrocarbon Research, Inc.,[9] has announced that the first application of the Hydrocol process is to be made for Carthage Hydrocol Co. in a plant to be erected at Brownsville, Tex. This plant is being designed to process 64,000,000 cu. ft. of natural gas per day to produce 5,800 bbl. of motor fuel, 1,200 bbl. of diesel fuel, and 150,000 lb. per day of crude alcohols.

P. Ryan of the Kellogg Co.[8] states: "A complete Synthol plant to produce a large volume of liquid hydrocarbon, it is presently estimated (April 1945), would have a payout time of approximately 8 years. A combined Synthol and chemical plant, it is presently estimated, would have a payout time of approximately 3 years." No information is given on quantities or nature of chemicals produced.

A recent summary article on "Fischer-Tropsch Synthesis and the Petroleum Industry"[10] reports that: "In 1923 Franz Fischer and Hans Tropsch reported the reduction of carbon monoxide in the presence of alkali-iron catalysts at 750°-840° F. and 1,500-2,200 psig. The product was a mixture of aliphatic alcohols, aldehydes, ketones, acids, esters." Acetic and propionic were shown to be the principal acids, and ethyl and propyl to be the principal alcohols. Appreciable amounts of acetone were reported.

As indicated in Fig. 3, the production of these oxygenated derivatives is through the carbon monoxide-hydrogen route, similar to the previously discussed methanol synthesis. It is interesting to note that it is reported that the carbon monoxide-hydrogen mixture will be produced by the partial oxidation of natural gas with oxygen (not air) as the oxidizing medium. This method is said to be more economical than conventional steam-methane reforming, and also gives a hydrogen to carbon monoxide ratio closer to the desired value for the optimum synthesis reaction.

It is well to point out that the potential availability of cheap oxygen, perhaps as low as 5 cents per 1,000 for large installations, will undoubtedly have an effect on other oxidation syntheses besides the above-mentioned Fischer-Tropsch processes. A recent article by W. Lobo of the Kellogg Co.[11] on the production of oxygen by a variation of the so-called Linde-Frankl cycle, confirms this probability.

Acetylene is certainly a potential large-scale natural-gas derivative. Pilot-plant work has been under way at University of Texas on the so-called silent discharge or high-frequency electric arc process. Petroleum Chemicals, Inc., announced plans, prior to the war, for commercial production of acetylene by the Wulff regenerative furnace or high-temperature cracking process, developed through the pilot-plant stage by Tennessee-Eastman.[12] Hydration of acetylene yields acetaldehyde which can be converted into acetic acid, acetic anhydride, and numerous other oxygenated chemicals. The acetaldehyde will, of course, have competition from two other oxidation processes—the direct oxidation of paraffin hydrocarbons, and the oxidation of synthetic ethyl alcohol.

Two recent news releases are of particular interest to the oxidation petrochemical field, one that a decision is pending on the erection by Shell Chemical Co. of a plant in the Southwest to produce glycerol from propylene,[13] the other summarizing the U. S. Naval Technical Mission's report on the partial oxidation of ethane to ethylene,[14] as was used by I. G. at Leuna during the war.

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New 800 Psi. Working Pressure

GAS PIPE LINES

Connect Five California Fields

by E. H. Fisher*

THE Pacific Public Service Co. Suisun Bay gas pipe-line system will serve the dual purpose of providing an outlet for recent natural-gas discoveries in the Suisun Bay, Kirby Hill, and Cache Slough areas, and also supplement and increase this company's facilities for serving an increasing domestic and industrial market in Contra Costa County. The line will also provide an additional outlet for gas from the west side of the Rio Vista gas field.

The pipe-line system is designed for 800 psi. working pressure. It will provide a delivery into the Standard Pacific gas line at Pittsburg, Calif., of 57,500,000 cu. ft. per day at 500-lb. field pressure. Pacific Public Service, by virtue of its ownership in Standard Pacific Gas Line, Inc., has the right to five-fourteenths of the capacity of this "Stanpac" line. The new system is composed of 2.1 miles of 12-in., 6.8 miles of 10-in., 12.3 miles of 8-in., 11.8 miles of 6-in., and 2.9 miles of 4-in. pipe, making a total of 35.9 miles of pipe line.

The branch lines will gather production from approximately 17 wells located in the Suisun Bay, Kirby Hill, Honker Bay, Cache Slough, and West Rio Vista gas fields, with a combined production rate of 108,300,000 cu. ft. per day.

Cost of the system is estimated to be about $900,000.

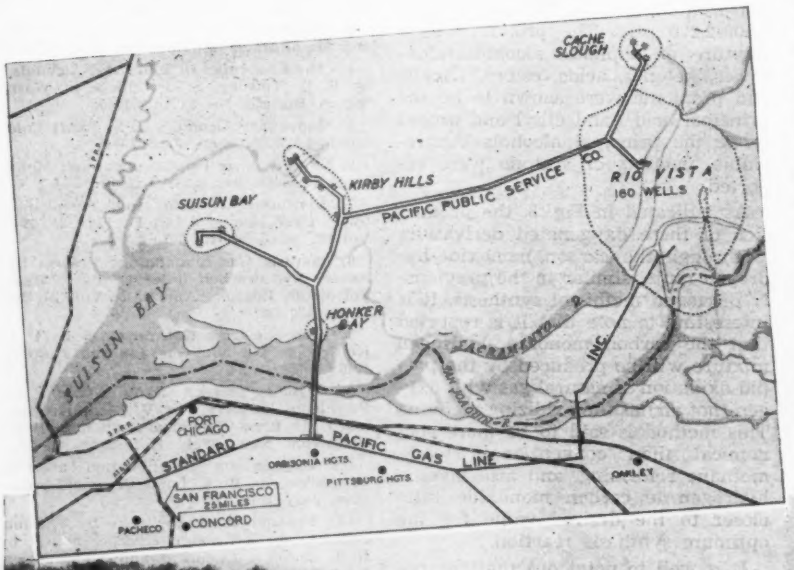
*Chief engineer, Pacific Public Service Co.

Construction Features

Construction of this line will include about 3.1 miles of water crossing. The line will cross the Sacramento River channel at the Shell Chemical Co. plant near Pittsburg, and proceed northeasterly across Honker Bay. The channel itself is about 4,300 ft. wide at this location and about 55 ft. deep at the deepest point measured from low-water level. The Honker Bay crossing is 9,100 ft. across, varying in depth from 4 to 9 ft. from the low-water level. This water crossing is continuous and presents a number of construction problems. Design of the crossing provides for minimum cover in the channel of 4 ft., and in Honker Bay 1 ft.

The line crosses a number of sloughs, although only two are considered navigable, namely Montezuma Slough which is 500 ft. across and 31 ft. deep, and Nurse Slough, 600 ft. across and 23 ft. deep. The line is to be buried 4 ft. under these sloughs.

One of the connected wells is located in Suisun Bay about 1,600 ft. offshore. The line to this well will be buried 6 in. below the bottom of the bay. This well is completed in two sand structures, one to be pro-



Left: Map of Pacific Public Service Co.'s Suisun Bay gas pipe line. Below: Welding crew working on a section of the line

duced through the casing and the other through the tubing. The two individual meters will be installed on a platform supported on piling above high-tide level.

Access to the areas in which the discovery wells are located is very difficult. At present the road to the Honker Bay well is impassable in the rainy reason. Plans are under way to construct an all-season road to this well. This general island area is rather inaccessible from the south side of the Sacramento River. Nearest route from that point by automobile or truck is by way of the Antioch Bridge, Rio Vista, and auto ferry to the islands—a distance of about 45 miles. Pipe and other materials for this part of the pipe line construction are to be loaded on barges and floated up Montezuma Slough to Duttons Landing and Meins Landing for further distribution. Standard Oil Co. of California has two wells on an isolated rise northwest and across Nurse Slough from Kirby Hill. All drilling equipment was barged in. It will be necessary for the well operator to take a boat to reach these wells.

The area covered by Wheeler, Hammond, and Grizzly islands is mostly low swamp land with a fairly high water table. A great deal of this land has been reclaimed by construction of levees and deep drainage ditches; however, Wheeler Island is still marsh. The pipe-line construction is scheduled for the driest season of the year on these islands.

Wheeler Island is purposely flooded annually about October 1 and prepared for duck season. In order to cooperate with the landowners, it was necessary to complete the pipe-line construction in this general area and minimize the traffic by October 1 so as not to interfere with a successful hunting season.

Where land has been reclaimed and leveled for cultivation, the pipe line will be buried with 3 ft. of cover. Where the land has been reclaimed and is awaiting improvements for cultivation, the pipe will be buried with 4 ft. of cover. Other sections of the line will have the usual 18 in. of cover.

Telemeters to Control Delivery

The delivery into the Stanpac line is large enough to indicate the need of either a 24-hour attendant or some other means of supervision. This problem is to be solved through the medium of telemeters. A flow-and-pressure telemeter will be installed at the terminal, together with carrier equipment, utilizing the Stanpac telephone circuit for transmission to the receiving equipment at the Antioch control station. Duplicate receiving equipment will be installed at Pacific Public Service office at Pittsburg. Arrangements are also being made to install a recording gravitometer.

Because of the difficulties of transportation and communication between the fields north of the river and the transmission system south of the river, it is probable that considerable reliance will be placed on radio communication. Two of the producing companies at Rio Vista now have such equipment and it is probable that it will be utilized in combination with telephone communication in the operation of this line.

The entire line wlil be Somastic coated by Bechtel Brothers McCone Co. at its plant in Pittsburg.

Provision has been made to remove water and condensate from the gas prior to delivery into the Stanpac line. The equipment consists of four drop-leg drips located along the line at the lower points, plus a scrubber of sufficient capacity to handle 70,000,000 cu. ft. per day at 300 psi. pressure.

Contract for construction of the pipe line was awarded to Pacific Pipeline Construction Co. Work began on August 26, 1946, and is scheduled for immediate completion.

Above: Building pressure to 1,000 psi. for testing section to be pulled across 600-ft. Nurse slough near Suisun Bay. Right: Boring under a Sacramento Northern Railroad bed near Suisun Bay for passage of new natural-gas line. Extreme right: Dredge winches were used to pull section of pipe line across 500-ft. Montezuma slough

Lateral Drilling Project

This portable rig is shown rigged up over Shell Oil Co., Inc.'s, Round Mountain field well and working on lateral-drilling operation

Makes nine drain holes totaling 458 ft. of sand in one well

by
H. Stanley Norman

PRACTICALITY of drilling horizontal or lateral drain holes into an oil-sand body, and the efficiency of equipment developed for this particular purpose have been reaffirmed by successful mechanical completion of another project in California. The most recent application of the Zublin method of drilling lateral drain holes into oil sand was by Shell Oil Co., Inc., in the Round Mountain field, Kern County, about 15 miles northeast of Bakersfield.

The well selected for the work was bottomed at 1,720 ft., and had 8⅝-in. casing cemented at 1,381 ft. The main oil sand is concentrated in a body of approximately 80 ft. in thickness near the bottom of the well. Average permeability for the sand

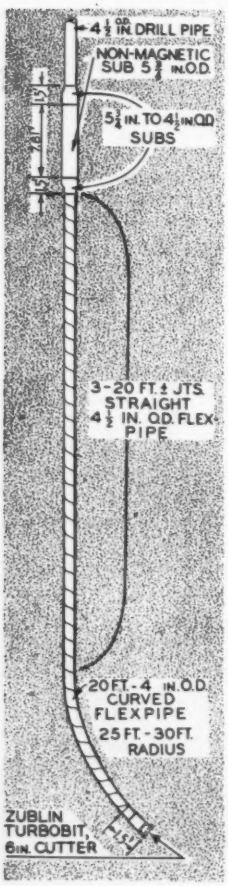

4½ DP. IN. DRILL PIPE
NON-MAGNETIC SUB 5½ IN. O.D.
5½ IN. TO 4½ IN. O.D. SUBS
15'
2.81'
15'
3-20 FT. ± JTS. STRAIGHT 4½ IN. O.D. FLEX-PIPE
20 FT. - 4 IN. O.D. CURVED FLEX PIPE
25 FT. - 30 FT. RADIUS
ZUBLIN TURBOBIT, 6 IN. CUTTER

Fig. 1—(Left) Sketch showing tool string used in drilling Zublin horizontal drain holes

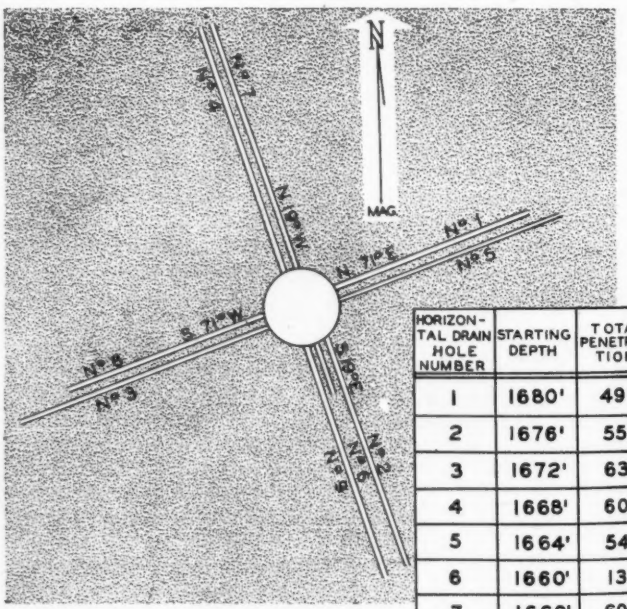


Fig. 2—(Right) Diagrammatic sketch showing scheduled orientation of horizontal drain holes

HORIZONTAL DRAIN HOLE NUMBER	STARTING DEPTH	TOTAL PENETRATION
1	1680'	49'
2	1676'	55'
3	1672'	63'
4	1668'	60'
5	1664'	54'
6	1660'	13'
7	1660'	60'
8	1656'	49'
9	1650'	55'

zone is in the order of 100 millidarcys, although no core analysis was available on this particular well.

The Zublin turbine bit is forced against the wall of the vertical hole and exits into a curved and eventually into a horizontal direction by specially designed pipe. A curved, flexible joint is used at the lower end of the pipe string immediately above the turbine bit. The curved joint is heat treated to sustain its form. The radii of curvature range from 20 to 35 ft. Curved joints used on the Shell operation were all 25 ft. in radius, except for one joint used in drilling two drain holes and it had a radius of 30 ft. It is claimed for the 25-ft.-radius joint that the force of gravity will allow the bit to continue in an approximately horizontal direction once it has reached this position as the bit continues to make hole.

Before the curved flexible joint is run into the well, it is straightened with the aid of a portable clamp installed on the derrick floor. In the straightened position, a mandrel is inserted as a core through the curved section. The mandrel is equipped with a spear at the top for the purpose of withdrawing it from the curved section. After the flexible pipe has reached its point of operation, the mandrel is withdrawn by means of retrieving tools run on a sand line. The curved pipe then assumes a curved form within limits of the hole at this point. Curve of the pipe forces the bit against the side wall of the vertical hole and into position for starting the curved and lateral drilling operation.

Other flexible drill pipe is used above the curved joint. The uncurved flexible pipe consists of 4½-in. external flush joint drill pipe. Flexibility is achieved by a continuous spiral slot cut through the wall of each joint, except for an interval of 15 in. at each end. The spiral cutting of the straight flexible pipe provides the flexibility required for the pipe to follow into the curved and horizontal positions.

The joints are lined with high-pressure, synthetic rubber hose, made fluid tight at each end to prevent leakage of the circulating fluid. The power to rotate the turbine bit is derived from fluid pumped down the drilling string. In the Shell test, Zublin engineers recommended a flow of approximately 7 bbl. per minute, necessitating an average pump pressure of about 600 psi.

Turbine Bit Assembly

The turbine bit assembly consists of three main parts: (1) the housing which carries the nozzles of the turbine; (2) the shank member carrying the turbine runner mounted on ball bearings within the housing, and (3) the cutter element which is mounted on ball bearings and is free to rotate about an axis which is inclined with respect to the axis of rotation of the shank.

The cutting action of the bit is credited to the tendency of the bit to cut opposing teeth in the formation facing the teeth of the cutter. If the bit were hanging free, the cutter would rotate at approximately the speed of the turbine or about 4,000 r.p.m. However, as the cutter face is forced against the formation, these "rock" teeth retard the rotation of the cutter by the ratio of 1 to 10.

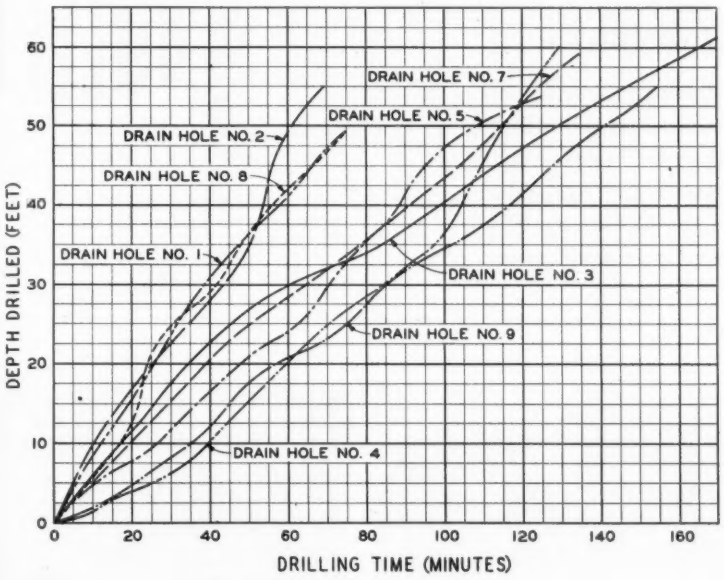


Fig. 3—Depth versus time curves

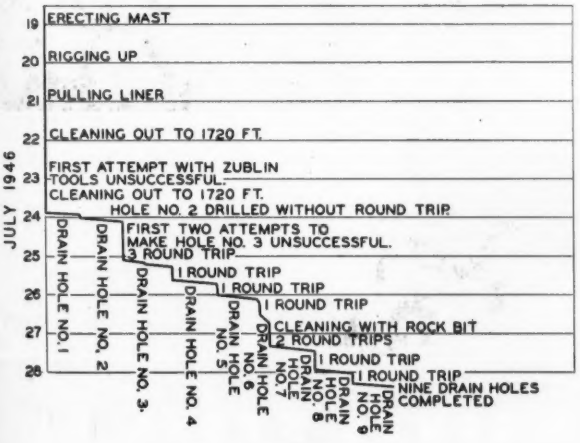


Fig. 4—Progress curve

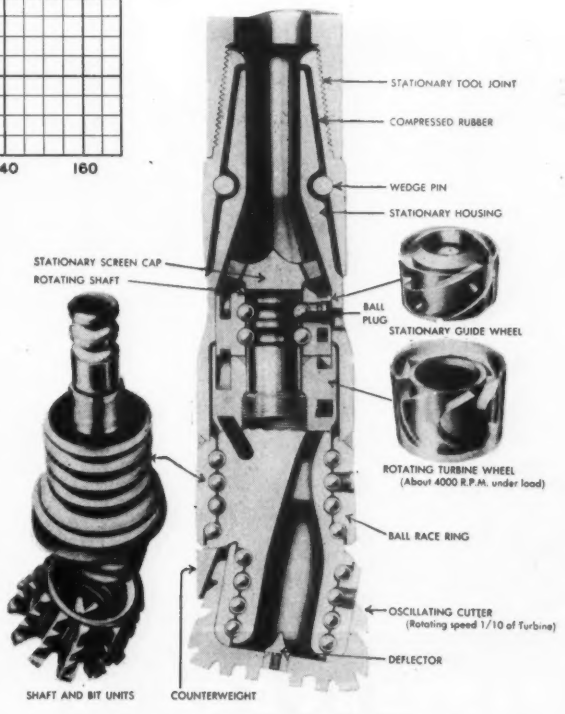


Fig. 5—Cross-section of Zublin turbine bit

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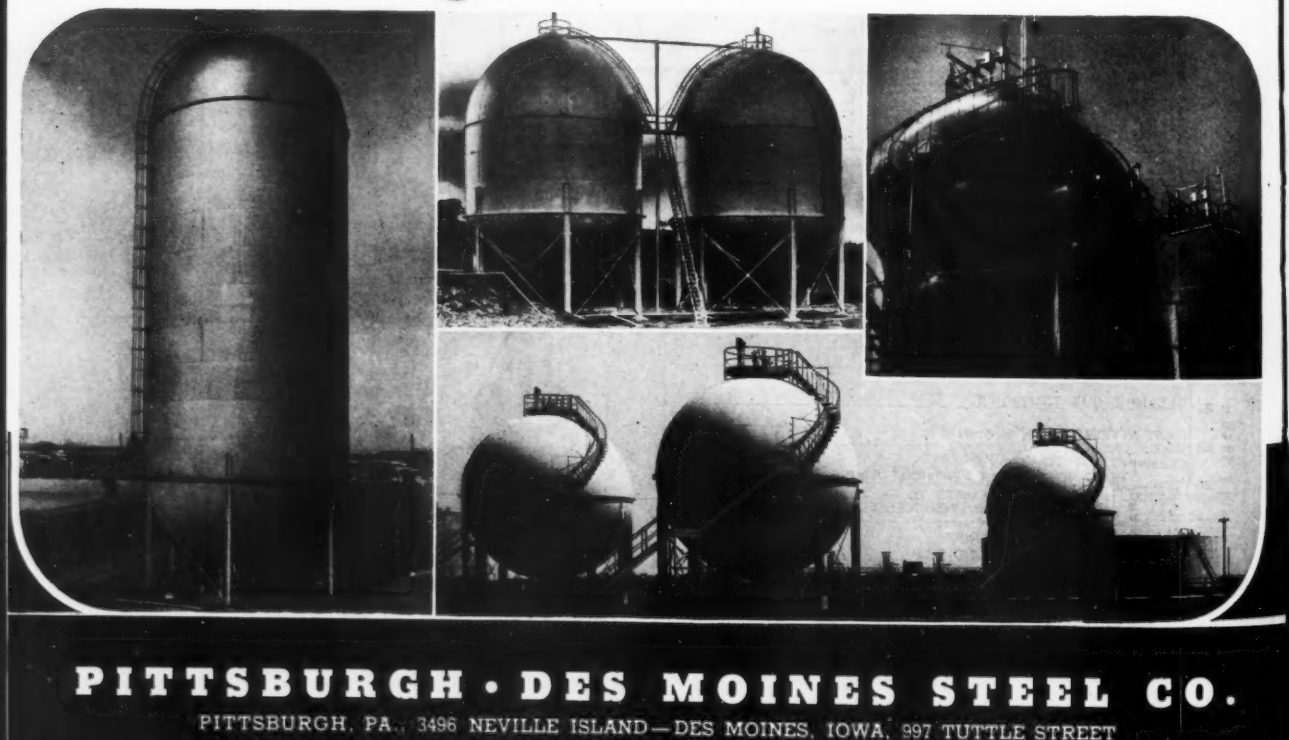
Our long familiarity with refinery storage problems joins with broad research and complete fabricating facilities, to provide the sphere or bullet installation best serving your specific needs. Types, capacities, metals and equipment are engineered to do the job—efficiently, economically, and with guaranteed satisfaction. *Write for a consultation.*



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DALLAS, 1201 PRAETORIAN BUILDING · SAN FRANCISCO, 603 RIALTO BUILDING
SEATTLE, 1106 FIRST AVENUE, SOUTH

The cutter speed is thus about 400 r.p.m. about its inclined axis compared with 4,000 r.p.m. of the turbine and shank.

The cutter, however, "wobbles" at the rate of 4,000 times per minute, owing to the inclination of the cutter axis. The 1-to-10 reduction is attributed to the placement of the cutter teeth which are designed to remove one-ninth of the opposing "teeth" in the formation on each revolution of the turbine or the corresponding "wobble" of the cutter face. The cutting action of the bit depends in part on the tendency of the cutter teeth to lift and drop the bit.

The entire bit has an over-all length of 20 in. to permit the drilling of curved holes. Fluid pumped down the hole inside the pipe is discharged near the cutter teeth. Construction of the bit provides for disassembly and reassembly to permit replacement of turbine parts if worn by abrasive action of the drilling fluid.

Two methods of orienting the bit to the desired position for starting curved and horizontal holes were used in the Shell operation. The Zublin magnetic compass was used in positioning the bit for the first four of the nine holes. With exception of a steel swivel at the upper end, and a steel bullnose at the lower end, the compass housing is made of brass.

It is 6½ ft. over all in length and 2$\frac{3}{16}$ in. o.d. The timing mechanism to lock the compass needle is housed in the lower half of the unit.

Operation of Compass Unit

The compass unit operates as follows: A compressed spring exerts pressure on a leather packer within the tube; the movement of the packer, which in turn is connected to a long pin, is retarded and controlled by the flow of oil through a small orifice; approximately 12 minutes following the release of the mechanism, the pin compresses a small cylinder beneath the compass needle locking the needle in the position it holds at that moment. The needle will remain locked in this position until released at the surface. The upper section of the housing has a stainless-steel, hinged lug designed to orient the compass assembly in the same positions with respect to the nonmagnetic sub each time the compass is run into the sub on a sand line.

The nonmagnetic sub is constructed of stainless steel and is 7 ft. 10 in. over-all length and 5¾ in. o.d. The sub has an internal slot to insure positive orientation of the compass assembly with respect to itself. The sub is made a part of the drill-pipe string, being inserted above the final joint of flexible pipe and below the first joint of regular 4½-in. drill pipe. Only enough flexible pipe is required in the total string to cover the combined length of the curved hole and the projected length of the horizontal drain hole.

Flexible joints on pipe rack. Joint at left is curved to 25-ft. radius and one at right has radius curvature of 30 ft.

All joints of the flexible pipe and subs from the curved joint up to and including the nonmagnetic sub have vertical alignment marks chiseled at the ends of each joint. These marks, with the aid of a protractor, provide the means for determining the relative angles of adjacent joints. The algebraic sum of angles to the right and left provides the bearing of the nonmagnetic sub with respect to the curved flexible pipe and bit.

The magnetic compass is run inside the pipe on the sand line until it is positioned in the nonmagnetic sub. After a period of approximately 15 minutes the compass assembly is withdrawn from the string and the compass bearing of the nonmagnetic sub is thus determined. With this information, knowing the relative bearing of the nonmagnetic sub and the curved flexible pipe, the present compass bearing of the curved pipe and bit is thus determined. The string of pipe is then rotated at the surface to the desired azimuth.

As soon as the pump is started, actuating the turbine bit, the digging of a new hole in the wall of the vertical well is started.

Installing clamp which straightens curved joint before insertion in well casing

Second Method

The other method used in positioning the turbine bit in the Shell well was by surveying. The string of pipe was rotated to the predetermined position and the mandrel was pulled from the curved flexible joint after the bit had been oriented to the direction in which respective holes were scheduled to penetrate the formation. This method insured the free rotation of the entire string of pipe during the orientation of the bit. However, it was necessary to make a round trip for each drain hole using the survey method of orienting the bit because the mandrel can be inserted in the curved flexible pipe only on the surface.

The turbine bit performed satisfactorily on all drain holes. Frequent bit changes were made but this was done to assure trouble-free drilling. A total of four bits were used in drilling the 458 ft. of lateral hole, although considerably more footage could have been drilled. All bits were in service-

able condition at the time they were retired.

The flexible pipe performed satisfactorily in a majority of drain holes drilled. In the few cases where the pipe ruptured, halting further drilling progress, the failures were attributed to excess weight on the bit. The ideal bit weight recommended for use of the turbine bit and flexible pipe is about 1,000 lb.

Although the drain holes were stopped after penetrating 50 to 60 ft. into the sand formation, engineers who observed the operation believe that the holes could have been drilled to 80 or 100 ft. without mechanical difficulty.

Selected crude oil was used as the circulating fluid in drilling all drain holes in the Shell operation. Approximately 450 bbl. of oil were lost into the formation while removing the liner. Losses of oil totaled 650 bbl. while drilling the 458 ft. of drain holes. Thus, the actual loss of fluid while drilling the drain holes amounted to 1.4 bbl. per ft.

The rubber lining of the flexible pipe has a bursting pressure of 1,000 psi., necessitating care in selecting fluid which will permit the desired rate of circulation—6 to 10 bbl. per minute—with a maximum pressure of less than 900 psi. in the flexible pipe just above the turbine bit.

Significance and Future of Horizontal Drainage Holes

by John A. Zublin*

IT has now been demonstrated that horizontal drainage holes can be drilled from a vertical bore, at any depth and in any predetermined direction to the length of 100 ft. and more, without mechanical difficulties. These horizontal tributaries, extending radially into the formation, increase many times the area of contact with the oil sand and the total drainage sphere of the well while at the same time providing channels for the oil to flow towards the main bore. The number and length of lateral holes required to give maximum recovery from any particular well will be governed by the thickness, permeability, and degree of saturation of the oil sand, and the viscosity and other characteristics of the crude.

A significant improvement developed during the recent test for Shell Oil Co., Inc., was the use of oil instead of water or water-based mud as the motivating fluid for the turbine. This new technique eliminates the danger of impairing production by water flooding or "mudding" of the oil sand and has the added advantage of furnishing a helpful lubricating action.

Results of this latest drain-hole project have confirmed belief that one of the benefits of large drainage channels is to greatly reduce sand troubles. The rate at which oil flows through the large drain holes is so much less than in the case of ordinary wells, where only minute passages or cracks are available, that less sand will be dislodged and in any event will settle out before reaching the main bore of the well. This will result in considerable savings in liners, pumps, and other production equipment, as well as reduce the danger of wells sanding-up.

Thus far, drilling of horizontal drain holes has been confined to "old" or partially depleted wells, and all projects have been approached as methods of secondary recovery. It may well be, however, that far greater benefits will be derived from drilling in "new" wells. This would mean drilling horizontal holes into the oil sand immediately upon completion of the vertical bore and prior to placing the well on production. With a greatly increased drainage area, and unimpeded passages for the oil to travel from all directions to the central hole, the new well could be produced at a much higher rate without exceeding the limits of efficient production or encouraging sand problems, or other problems.

Slow and Uniform Drainage

Production of a well is in a sense an underground transportation problem involving the movement of oil and gas from distant points in the formation to the well with the least amount of turbulence and resistance to flow. In conventional wells the oil and gas must force its way horizontally at high velocities, through small openings and pores in the sand to a point in the well from where it will be lifted vertically and it is to be expected that in this race the more viscous gas will tend to bypass the oil. The slow and uniform drainage created by lateral holes, will preserve the gas pressure in the formation and maintain a more constant and controlled gas-oil ratio. These factors will undoubtedly bring about a greater ultimate recovery of oil, as well as a more rapid and consequently more efficient and economical recovery. This same contention applies to decreased water production, since, similarly, the tendency for the water to bypass the more viscous oil is less at a slower rate of production. This point has been definitely brought out in the tests thus far completed, since in all wells the percentage of water produced declined after completion of the drain holes.

Considerable thought has been given to the problem of reducing costs of drilling lateral holes. Since, in the process employed, the pipe remains stationary and only the bit rotates, no torque is set up, making it possible to use smaller pipe, which can be handled with light portable equipment. In this respect conditions are similar to well-servicing operations.

Costs can also be reduced by adopting a program calling for the drilling of drain holes in a number of wells. It then becomes profitable to use the best suitable equipment to complete all the jobs. In "new" wells, drain holes can be furnished at a fraction of the cost involved in "old" wells, since no special rigging up is required and the holes can be drilled within 1 or 2 days after completion of the main bore.

All equipment used in the drilling of horizontal drainage holes has been designed and constructed to make the operation as simple as possible. No special skill or technique is required and crews familiar with standard rotary drilling methods can be taught to operate drain-hole equipment by one simple demonstration.

*Inventor of the Zublin bit.

West Virginia Terminal Opened by Socony-Vacuum

NEW YORK. — A new 70,000-bbl. barge terminal was opened December 5 by Socony-Vacuum Oil Co., Inc. at St. Albans, W. Va.

Located on a 12-acre tract on the Kanawha River, the terminal will be used for storage and distribution of gasoline and kerosene, products which are shipped to the terminal by barge, then distributed by tank truck throughout western and central West Virginia.

Tank-car and truck loading racks, as well as so-called conservation tankage, are provided. The latter's roof rises as much as 5 ft. when vapor pressure increases. Evaporation loss is reduced by the use of subsurface loading spouts on tank truck and tank-car racks.

P. C. Fuller, station agent, is in charge. Harold J. Potts is division manager, and Herbert W. Gerlach is operating manager.

ELECTRIC POWER

in Oil Refining

by W. H. Stueve*

ALMOST every process in a refinery requires pumps of some type to handle liquids, and the simply constructed induction motor, direct connected to the centrifugal or rotary pump, readily lends itself to this situation, since low investments and low maintenance can be obtained.

As a refiner, one should be interested in the past performance and adaptability of electric power, from which study some idea of its general acceptance can be gleaned. If this past history reveals a gradual increased use of electric power by the industry as a whole, then it might appear obvious that plans for betterment of the plant should be predicated on following this trend. Information is available through the Bureau of Mines and Department of Commerce (Census of Manufacturers), Federal Power Commission, and The Oil and Gas Journal reports, which give the amount of oil processed and electric power usage, both generated and purchased, along with the horsepower of motors driving the plant equipment, which data, if properly used and analyzed, will disclose the trend toward use of more and more electric power as the years pass by.

Table 1 is prepared from data taken from the above sources, and certain logical deductions are made to identify the refining industry from "coal" products, since some reports carry "oil and coal products" as a single manufacturing item.

From the above assembled information, it can readily be seen that the use of electric power in terms of kw.-hr. per barrel charged to the stills has almost doubled in the 15 years—1929 to 1944 (1.78 to 3.18).

Increase in Horsepower

Also during this period of 15 years, the usage per horsepower connected has increased from 2,090 kw.-hr. in 1929 to 2,500 kw.-hr. in 1944, which indicates not only a longer use is being made of the motorized equipment, but that more dependence is being placed on the motors driving the critical pumps necessary for the continuous operation of the refineries.

Since the information shown in Table 1 covers both purchased and generated electric power, it is interesting to explore further to ascertain the amount of energy obtained from each source.

The Census of Manufacturers prepared by the Department of Commerce provides information up to 1939, and then the Federal Power Commission carries on for 5 years to 1944.

In 1939 there were 623,283 hp. of motors using purchased power, and 536,323 hp. using generated power produced from 263,122 active kw. of generators, which resulted in estimated annual load factors being achieved of 63 and 67 per cent respectively. From available information and data from statistical sources, certain reasonable deductions can be made which show the respective uses of both generated and purchased electric power. These ratios are shown in Table 2.

From Table 2, it can be noted that during the 10-year period—1929 to 1939—the spread between purchased

*Chief industrial consultant, Oklahoma Gas & Electric Co. A paper presented before the Petroleum Electric Power Association meeting at Tulsa, December 3-4.

TABLE 2—OIL REFINERIES, RATIO OF PURCHASED TO GENERATED ELECTRIC POWER

Year—	Purchased power— Per cent of total kw.-hr. required	Purchased power— Load factor	Generated power— Per cent of total kw.-hr. required	Generated power— Load factor
1929	50.5	60	49.5	65
1939	55.0	63	45.0	67
1944	65.0	67	35.0	70

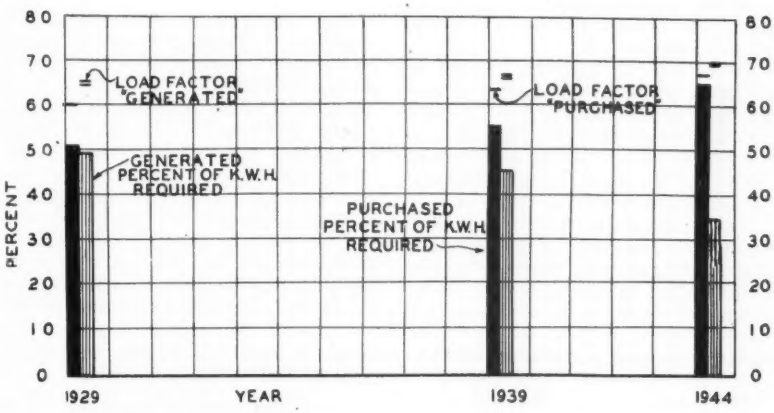
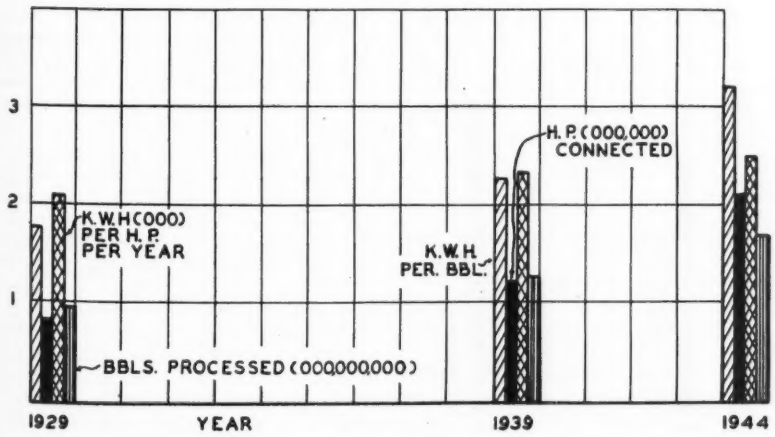


TABLE 1—ELECTRIC POWER USAGE BY PETROLEUM REFINERS

Year—	Processed (bbl.)	Consumed (kw.-hr.)	Connected (hp.)	Kw.-hr. per bbl.	Kw.-hr. per year per hp.
1929*	930,000,000	1,653,000,000	790,000	1.78	2,090
1939	1,237,000,000	2,772,000,000	1,159,000	2.24	2,380
1944	1,640,000,000	5,210,000,000	2,080,000	3.18	2,500

*Estimated.



and generated power only increased at the rate of about ½ per cent per year, yet during the recent war period of 5 years, this spread became more pronounced since the rate was 2 per cent per year.

Thus, today the oil refinery purchases about 2 kw.-hr. for every kilowatt hour it generates. Of course, this situation cannot be taken as a definite trend—it has to stop somewhere—for the reason that generating equipment could not be obtained during the war. Another reason may be that steam balances may dictate this arrangement.

The Over-All Picture

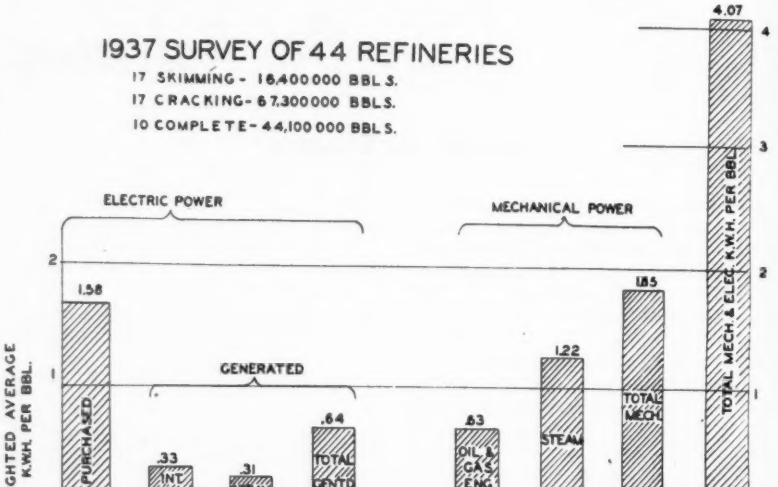
Since the oil-refining business is classified as a manufacturing institution, and specific data regarding its operations are included with all manufacturing institutions (some 200,000) in the United States, a look into the over-all picture of this composite group would seem pertinent at this point to determine the trend in usage of electric power. Table 3 is submitted (Reference National Planning Board Report of 1942) to illustrate the relation between purchased and generated power for the 15-year period covered by this report.

From Table 3, note the gradual increase in use of purchased power during the 15-year period 1929 to 1944, also the drop in use of hydro-generated power in the 10-year period 1929 to 1939, all based on horsepower of equipment used.

As expected the use of internal-combustion engines has increased slightly (6 per cent) during this 10-year period, whereas hydro power decreased 11 per cent.

TABLE 4—1937 SURVEY OF 44 REFINERIES—KW.-HR. PER BARREL

Electric power					Mechanical power		
	Net generated			Total purchased and generated	Oil and gas Engine	Steam	Total
Purchased	Int. comb.	Steam	Total				
1.58	.33	.31	.64	2.22	.63	1.22	1.85



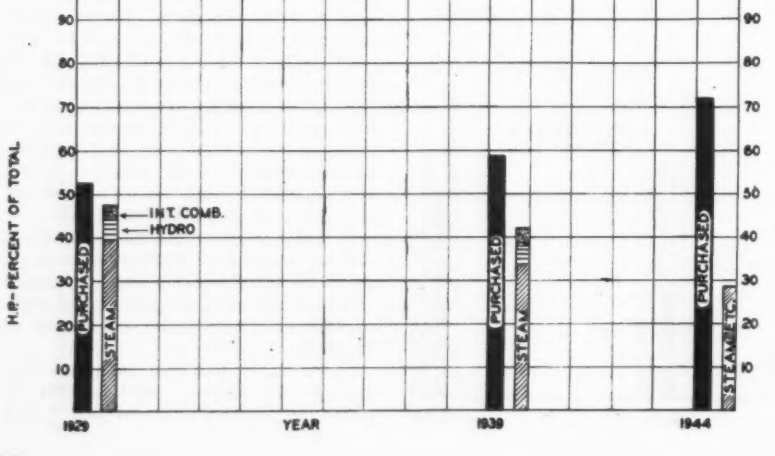
The oil-refinery power usage, as disclosed in Table 2, does not exactly fit this situation for all manufacturing industries, yet the general trend is obvious. The reason for this slight differential in trends, when comparing the "refining" with "all industries" is due to the fact that greater amounts of process steam, per unit of product, are required by the refiner as compared to the over-all manufacturer, and the use of process steam therefore gives the refiner an opportunity to produce some of his electric requirements with a low fuel rate. This fact accounts for the ratio of 65 to 35 per cent of purchased to generated power required in refineries for 1944 (Table 2) as compared to a ratio of 72 to 28 for all manufacturing industries for the same year, based on horsepower connected.

As explained previously, the supporting data shown in Tables 1, 2, and 3 were all taken from Department of Commerce and Federal Power Commission reports, but to lend further support to such information, a study of 44 refineries was made in 1937, which processed about 10 per cent of the total oil products in that year, and the results are shown in Table 4.

TABLE 3—POWER EQUIPMENT IN ALL MANUFACTURING INDUSTRIES—PER CENT OF TOTAL HORSEPOWER IN PRIME MOVERS AND MOTORS

	Generated in plants				
Year—	Purchased	Hydro	Internal combustion	Steam	Total
1929	52.3	4.6	3.5	39.6	47.7
1939	58.2	4.1	3.7	34.0	41.8
1944*	72.0	...	...	...	28.0

*Based on kilowatt hours consumed in industrial use.



Power Produced

Included in this study were 17 skimming plants processing 16,000,000 bbl., 17 cracking plants processing 67,000,000 bbl., and 10 complete plants processing 44,000,000 bbl. By using weighted averages the results in Table 4 are obtained to indicate all forms of electric power required and also the amount of mechanical power produced, all resolved to kw.-hr. per barrel.

From these data, it can be noted that the total electric power required, 2.22 kw.-hr. per barrel, is almost exactly equal to the amount found from the Department of Commerce information for 1939, as shown in Table 1 of 2.24 kw.-hr. per barrel. Also that the ratio of purchased to generated is 72 per cent to 28 per cent (1.58 to 0.64 kw.-hr. per barrel), which is identical with the results for 1944, as shown in Table 3 for all manufacturing industries on a comparable basis of actual

energy consumed and horsepower used.

This is the first time that the mechanical power requirements are used in this discussion, and this information is not obtainable from the Department of Commerce reports; however, it is shown here to illustrate the wide acceptance of all forms of electric power by the refining industry, even in 1937, or the prewar period. Thus, it may be said that the refining business is 54 per cent electrified today.

Now, one may ask, "What do all the figures and tables so far studied mean to the refiner?" Well, the trends shown mean something. The green light is seen to proceed with using electric motors for all new applications, and also to charge out obsolete steam-power equipment and replace it with motors. Another green light is seen to proceed with using more purchased power. Apparently less process steam is required, or the production of steam does not occur at times of electric demand.

However, the source of electric power—where and how it is obtained—is entirely another matter, and requires careful consideration.

In 1939 the average cost of purchased power was 0.73 cent per kw.-hr. at about 60 per cent load factor, which represented only 0.41 per cent of the total value of the refined products f.o.b. cars or pipe-line origin. The average cost of fuel was 8.5 cents per million B.t.u., and refiners required 557,000 B.t.u. per barrel of fuel. The refiner spent $58,479,092 for fuel in 1939 which represented 2.37 per cent of the value of the refined products; whereas, all electric power required cost only about one-third of the amount paid out for fuel.

Cheaper Operation

Generally speaking, a process steam plant will require about 5,000 B.t.u. fired under the boilers to produce a kilowatt hour, as against 17,000 to 20,000 B.t.u. fired to boilers in a conventional condensing steam plant.

The process steam plant can be installed somewhat cheaper than the condensing plant because no condensers are required, and it can be operated somewhat cheaper because condensing water is not required to be pumped. Also higher boiler efficiencies can be obtained at the higher initial pressures and temperatures required. The back-pressure turbine also is cheaper than the conventional condensing turbine.

These advantages are all reflected in the cost of energy produced, whether calculated on a straight depreciation or payout basis. The average cost of fuel for power utilities in the United States is about 12 cents per million B.t.u., which means that it costs them about 0.23 per kw.-hr.; whereas, the refiner with an average fuel cost of 8.5 cents per million B.t.u. could produce a kilowatt hour for 0.04 cent in a plant generating steam at 600 lb. and exhausting into the plant steam system at conventional pressures of about 200 lb. Thus, the average refiner would have an advantage of about 0.19 cent per kw.-hr. in fuel costs to start with over purchases, before any labor, maintenance, or fixed charges would be considered in either case. At 65 per cent annual load factor this would amount to $10.80 saving per kilowatt of firm capacity over purchases and leave $30.80 to apply on labor maintenance and fixed charges per kilowatt before exceeding the cost of purchased power of 0.73 cent per kw.-hr. the average for all refineries.

It seems reasonable to assume that the refiner would install standby equipment to insure continuity of service—perhaps one extra boiler of capacity equal to one-half of the firm capacity, and one spare turbine, which would represent an investment of perhaps $150 per kilowatt of continuous duty for the entire plant.

In using the payout plan, the refiner would consider only interest, taxes, insurance, and maintenance, approximating perhaps 6 per cent, to apply against the investment to determine his savings over purchasing his requirements. Also the operating labor cost, at conventional refinery load factor, would approximate 0.1 cent per kilowatt hour or $5.70 per kilowatt per year. Thus, labor and fixed operating costs would amount to $14.70 and leave $16.10 per kilowatt to retire the original investment of $150—or take slightly more than 9 years.

Now, any change in conditions, which a given refiner would encounter would be immediately reflected in his payout period, which in turn would tend to change his decision to install the generating plant. In the case mentioned above—9 years is a long time to work and operate a plant just to recover the money invested originally.

However, if the refiner uses waste fuels and nonmarketable products, which he considers of low value—then his only expense would be $14.70 per kilowatt of firm capacity, and he would have left $26.90 per kilowatt to return his original investment in 5.5 years. If fuel has no value whatsoever, then the investment can be returned in 4.6 years.

On the other hand, if purchased power costs were reduced 5 per cent, the payout period would be increased 10 per cent. Similarly, a reduction of purchased power of 10 per cent would automatically increase the payout period about 20 per cent.

There you have the picture of the case of electric power for the refining industry. Each case requires special consideration—and the answers are not obtainable from statistical data nor from studies made of small groups of refineries. Every refiner has charge of his own pocketbook and he is the sole judge of making wise expenditures for himself. This discussion, with the trends indicated, does prove beyond doubt, however, that the use of electric power is on the ascendancy and that it behooves each design engineer to examine his applications carefully before reaching his decision as to type of prime mover to install, and also find out from his management how quickly it desires to obtain its investment return.

Combination Steam and Electric Plants

There are 8 or 10 refineries, of fairly large capacity, which purchase all their steam and electric requirements from private utilities from plants located adjacent to the refineries. The refiner sells and delivers waste or nonmarketable fuels to the power plant, and the power plant absorbs the excess electric power so generated into the power system. Usually the refiner is required to take a given number of kilowatt hours from each 1,000 lb. of steam generated, possibly 12 to 15, and then the utility absorbs the other 18 or 15 kw.-hr. in its system, based on conventional water rate of 30-lb. steam per kw.-hr.

This arrangement gives the utility an opportunity to operate at all times noncondensing, and the refiner can balance the steam and electric load in his plant to better advantage with double-ended pumps or equipment using motors or low-pressure turbines. The water makeup problem in plants of this type becomes of prime importance, since about only 15 to 25 per cent of the condensed steam is returned for use. In some cases the makeup water and treating plants are more expensive than condensers in the conventional utility plant.

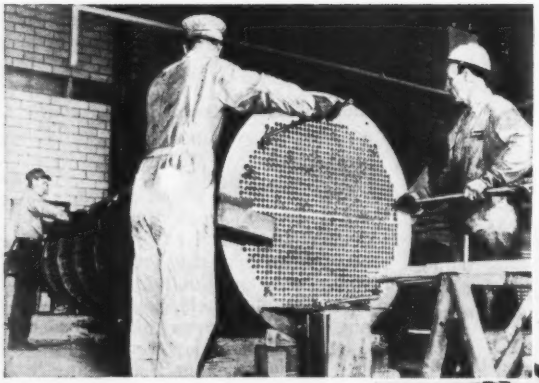
The plants of this type studied indicate an electric usage somewhat conforming to that shown herein for the average situation. Again the economies and long contract life of the refinery (possibly 15 to 20 years) are essential to make such a plan attractive to any power supplier.

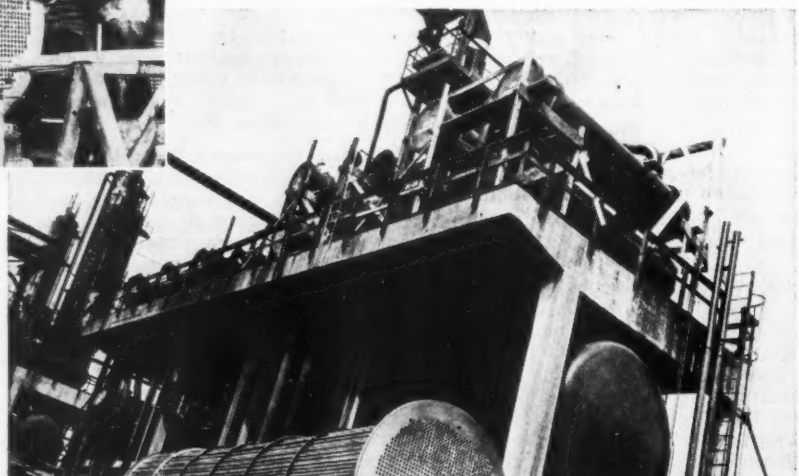
Flu Inoculations Provided

NEW YORK.—Many employes in refineries and offices of Socony-Vacuum Oil Co., Inc. are accepting the company offer of free influenza inoculations. Socony-Vacuum provides the inoculations without charge to the employe, and the plan is entirely voluntary. An employe will be given a second inoculation in 3 months if he wishes it, according to a company announcement.

Light Hydrocarbon from Fractionating Towers

handled by ANACONDA ARSENICAL ADMIRALTY TUBES...





(Above) Inserting Anaconda Arsenical Admiralty 439 Tubes in tube bundle at Houston, Texas, butadiene plant of Sinclair Rubber, Inc. Photograph at right shows tube bundle ready for installation in one of the shells on top of superstructure.

THE CONDENSERS shown in the photographs above are located at the butadiene plant of Sinclair Rubber, Inc., Houston, Texas. They were built to handle light hydrocarbon from the fractionating towers.

In order to provide the required heat transfer and economical service under the corrosive conditions encountered, the tubes being installed are Anaconda Arsenical Admiralty 439.

This Anaconda Alloy has been manufactured on a commercial basis since 1934. It is but one of 11 standard and several special condenser tube alloys currently produced by The American Brass Company.

This list provides tubes to meet a wide range of heat transfer requirements. The broad metallurgical knowledge and practical experience of our Technical Department is available in helping you make the right selection. 40174

ANACONDA

Anaconda

CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

Well Capacity

OIL PRODUCTION by water

PART 8 OF A SERIES

*by Park J. Jones**

THE producing capacity of wells varies with the number of wells, interference between wells, completion in pay, permeability, and drawdown. The required producing rate from a given reservoir varies primarily with the per-interval acre-feet of pay. The required rate of production from one sector in a given pay interval may be much faster than that from some other sector in the same interval. The factors controlling the required number of wells are considered from the sectional and areal viewpoints. Well capacity is also considered relative to variable reservoir and bottom-hole operating pressures. A bottom-hole pressure which is less than the saturation pressure for oil may be accompanied by a rapid decline in well capacity. The drilling of additional wells does not increase well capacity for reservoirs already saturated with wells. Pressure maintenance by water injection is essential to maintaining well capacity.

Sectional Convergence of Pay

THE optimum locations, for wells producing oil by water from a reservoir having no primary gas cap, are on the crest of the structure. But pay thickness in which wells are completed may not be proportional to the average pay thickness for an interval. Hence, control of producing rates may also be influenced by sectional convergence of pay. If all other factors are uniform, we have:

$$n_i = \frac{H_i \Sigma h_i}{h_i \Sigma H_i} \qquad (1)$$

where

n_i = relative completions in the ith interval
h_i = average pay thickness in which wells are completed
H_i = average pay thickness for the ith interval

When $h_i = H_i$; $n_i = 1$ and all intervals require the same number of completions. Therefore, a uniform pay thickness has no influence on the number of completions for producing rates proportional to reserve.

Example 1.—Estimate the number of completions for the following conditions:

Interval—	1	2	3
Pay thickness, H_i, ft.	15	20	25
Completion in pay, h_i, ft.	20	15	15
Solution by Equation 1:			
$H_i \Sigma h_i$	750	1,000	1,250
$h_i \Sigma H_i$	1,200	900	900
Relative completions	0.63	1.11	1.39
Completions, per cent	20.1	35.5	44.4

If h_i were equal to H_i, each interval would require the same number of completions, namely, 33.3 per cent of the total.

The General Equation

Sectional convergence may be combined with variable pay thickness h, well interference I, permeability K and drawdown ΔP to obtain:

$$n_i = \frac{H_i \Sigma (IhK\Delta P)_i}{(IhK\Delta P)_i \Sigma H_i} \qquad (2)$$

where n_i is the relative number of completions, see Part 7 of this series (December 14, 1946, issue).

Let N be the total number of wells. The number of wells N_i required by the ith pay interval is given by:

$$N_i = N \frac{n_i}{\Sigma n_i} \qquad (3)$$

Number of Wells vs. Rate

The well capacity for any interval is proportional to the product of the factors $(NIhK\Delta P)$. The required producing rate is proportional to the average pay thickness H for an interval if producing rates are proportional to reserve. Since pay thickness may vary with structural position, the pay thickness in the region where wells are completed may be more, or less, than the average pay thickness for an interval.

Suppose the number of wells drilled into a reservoir is fixed. Let the reservoir have two, or more, pay intervals of variable I, h, K, and ΔP. But let the average pay thickness H be fixed. It follows that the value of $\Sigma (NIhK\Delta P)_i$ is higher when $h_i = H_i$ than the corresponding value when the completion in pay h_i is not equal to the average per-interval pay thickness H_i. Therefore, sectional convergence of pay forces either the drilling of additional wells or an increase in the drawdown if it be desired to maintain producing rates proportional to the average pay thickness.

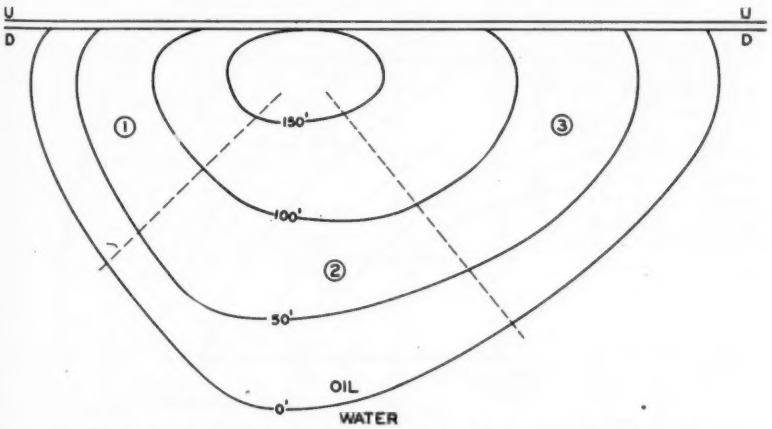


Fig. 8-1—Contours on top of a reservoir showing elevation above the water contact; dashed lines separate the reservoir into three sectors

Areal Asymmetry

Consider one pay interval from an areal viewpoint. Structure and stratigraphy are commonly asymmetrical with respect to the crest of a reservoir. Fig. 8-1 is an illustrative example. The water contact is along the zero contour. The closure is 150 ft. The two dashed lines separate the reservoir into three sectors. For this condition we have:

$$n_i = \frac{(aH)_i \Sigma (IhK\Delta P)_i}{(IhK\Delta P)_i \Sigma (aH)_i} \qquad (4)$$

where n_i denotes the relative completions in the ith sector. The other symbols have the same meaning as above except that the viewpoint is here areal rather than sectional.

The per-sector number of completions N_i for no migration of oil or water across an imaginary boundary of a sector is given by $Nn_i/\Sigma n_i$ where N is the total number of wells for all sectors.

Example 2.—Estimate the number of wells required for each sector in Fig. 8-1 for the conditions given below:

Sector—	1	2	3
Relative area, a_i	1	2	3
Relative pay thickness, H_i	1	1	1

*Production consultant, Houston.

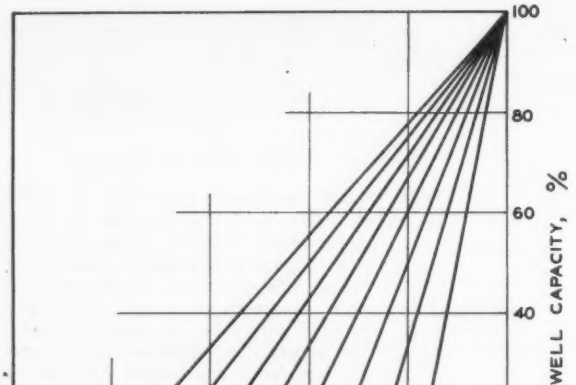


Fig. 8-2—Well capacity vs. reservoir pressure for various operating bottom-hole pressures P_b/P_o

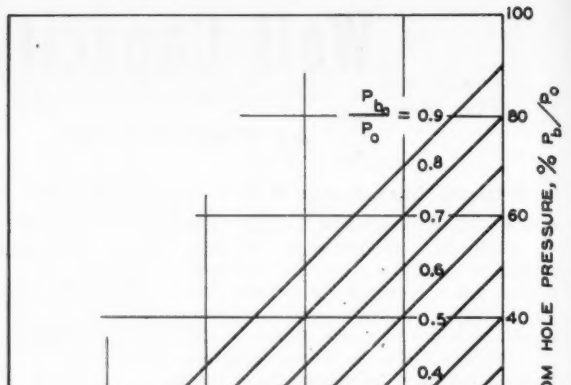


Fig. 8-3—Operating bottom-hole pressure P_b/P_o required to maintain a constant well capacity vs. reservoir pressure and initial operating bottom-hole pressure P_{bo}/P_o

Relative completion thickness, h_i		1	1	1
Relative drawdown, ΔP_i		1	1	1
Relative permeability, K_i		2	1.5	1
Solution aside from I_1:				Σ
$(aH)_i$	1	2	3	6
$(hK\Delta P)_i$	2	1.5	1	4.5
$(aH)_i \Sigma (hK\Delta P)_i$	4.5	9	13.5	
$(hK\Delta P)_i \Sigma (aH)_i$	12	9	6	
n_i	0.375	1.000	2.250	3.625
N_i	10	28	62	100

If a total of 100 wells were drilled, 10 would go into Sector 1, 28 into Sector 2 and 62 into Sector 3. These data are aside from well interference. The number of wells will now be corrected on the assumption that the wells are one, two, and three-row systems.

Sector	1	2	3	Σ
I_i	0.64	0.384	0.262	
a_i	1	2	3	6
K_i	2	1.5	1	
$(IK)_i$	1.28	0.576	0.262	2.118
$a_i \Sigma (IK)_i$	2.118	4.236	6.354	
$(IK)_i \Sigma a_i$	7.68	3.456	1.572	
n_i	0.276	1.226	4.042	5.544
N_i	5	22	73	100

The reserve in, and the permeability of, Sector 3 require 6.2 wells for each well in Sector 1 aside from interference. With interference, the ratio is 73/5 or 18.6 : 1, whereas, the reserve ratio is only 3 : 1. These considerations are based on uniform bottom-hole operating pressures and a uniform pressure along the entire water contact.

Bottom-Hole and Saturation Pressures

Suppose a reservoir has 90-120 producing wells. The drilling of additional wells is not likely to increase the total well capacity if the 90-120 wells already constitute a three-row system and the wells are operated at the minimum bottom-hole pressure. A decline in reservoir pressure causes a decline in well capacity relative to a fixed bottom-hole operating pressure. From the viewpoint of reserve, the optimum operating reservoir pressure for oil production by water usually is between 75 and 85 per cent of the saturation pressure. But the latter may be anywhere from, say, 400 up to 6,000 psia. The initial reservoir pressure may be anywhere from, say, 1,000 up to 6,000 psia.

An oil is said to be saturated or undersaturated relative to an initial reservoir pressure. But when dealing with the producing capacity of wells, the bottom-hole operating pressure is a more convenient reference pressure. For an undersaturated oil, the bottom-hole operating pressure is not less than the saturation pressure.

We wish to examine the influence of reservoir and bottom-hole pressures on the capacity of three-row well systems for producing oil by water. The latter may encroach naturally or be injected along the water contact. Bottom water is excluded. Production by expansion is not included.

Let Q_o be the well capacity when the reservoir pressure is P_o and the operating bottom-hole pressure, P_{bo}. The well capacity Q, at the time the reservoir pressure is P and the bottom-hole operating pressure P_b, is given by:

$$Q = Q_o \frac{P - P_b}{P_o - P_{bo}} \qquad (5)$$

The lines in Fig. 8-2 are solutions of Equation 5 for constant bottom-hole operating pressures. Suppose the minimum bottom-hole flowing pressure is 60 per cent of the initial reservoir pressure, that is, $P_b/P_o = 0.6$. At the initial pressure, P_o, the well capacity is 100 per cent. A decline in reservoir pressure reduces flowing well capacity along the 0.6 line. Sup-

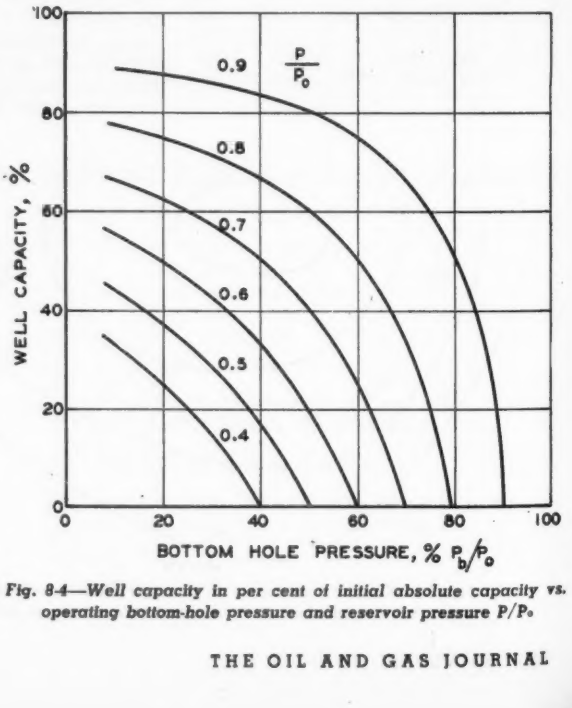


Fig. 8-4—Well capacity in per cent of initial absolute capacity vs. operating bottom-hole pressure and reservoir pressure P/P_o

pose the minimum bottom-hole pumping pressure is 10 per cent of the initial reservoir pressure. The decline in well capacity with decreasing reservoir pressure would follow the 0.1 line if the initial pumping capacity were 100 per cent and pressure were the only factor influencing well capacity.

The lines in Fig. 8-3 are for a constant well capacity. The lines show the reduction in bottom-hole pressure required in order to produce at a uniform rate as reservoir pressure declines.

The absolute capacity is used as a basis for comparing, say, flowing and pumping capacities when pressure is the only factor influencing well capacity. The curves in Fig. 8-4 are examples. The well capacity at the initial reservoir pressure P_o and zero bottom-hole pressure is 100 per cent well capacity. Suppose the flowing bottom-hole pressure is 60 per cent and the reservoir pressure 80 per cent. The corresponding well capacity is 50 per cent of the absolute capacity. Let the pumping bottom-hole pressure be 10 per cent. The pumping capacity at 80 per cent reservoir pressure is 87.5 per cent of the absolute capacity. The ratio of pumping to flowing capacities is here 87.5/50 or 1.75. The pumping capacity is 75 per cent higher than the flowing capacity.

Well Capacity for Saturated Oil

Suppose the bottom-hole operating pressure is less than the saturation pressure for an oil. Let Q_s be the well capacity relative to no free gas and aside from expansion. The well Q relative to free gas but aside from production by expansion is given by:

$$Q = Q_s \left(\frac{K}{K_s}\right)\left(\frac{b_s}{b}\right)\left(\frac{\mu_s}{\mu}\right)\left(\frac{P-p}{P_o-p_o}\right) \quad (6)$$

where

K/K_s = relative permeability
b_s/b = relative volume factor
μ_s/μ = relative viscosity
P_o = initial reservoir pressure
p_s = bottom-hole operating pressure not less than saturation pressure
P = reservoir pressure at any time, $P < P_o$
p = bottom-hole pressure at any time, $p < p_s$

The influence of pressure and drawdown on well capacity is the same as in Equation 5. The approximate relative permeability is given by the curves in Fig. 4 of Part 7. The relative volume factor usually increases at a slower rate than the rate of decrease in relative viscosity. Consequently, the product $(b_s/b)(\mu_s/\mu)$ is commonly less than unity. For instance, a pressure decline may be accompanied by a 1.1 volume factor ratio and a 1/1.2 viscosity ratio. The product would be equal to 1.1/1.2 or 0.92. The corresponding relative permeability may be 0.5. The combined effect of permeability, volume factor, and viscosity would be 0.5 (0.92) or 0.46. In this example, the presence of free gas reduced well capacity down to 46 per cent aside from the influence of reservoir pressure and bottom-hole operating pressure.

Suppose a reservoir pressure is declining and the bottom-hole operating pressure is declined at the same rate so that the drawdown does not vary with time. A decline in the bottom-hole pressure down to about 75 per cent of the saturation pressure is likely to cause a 50 per cent decline in well capacity. A further decline in bottom-hole pressure causes a greater reduction in relative permeability because of higher free-gas saturation. But in addition, paraffin may start accumulating and begin plugging well bores. Accordingly, bottom-hole operating pressures which are less than saturation pressures may be accompanied by a rapid decline in well capacity.

If a reservoir is already saturated with wells produced at capacity, the drilling of additional wells is not likely to increase well capacity. Hence, for oil production by water, pressure maintenance by water injection is essential to maintaining well capacity.

REPUBLIC OF DALLAS
NATIONAL BANK

QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Persian Crude Oils

Have you any data covering the quality of Persian crude?—J. F. M.

Analysis of Persian or Iranian crude oils have been published by:

1. Egloff, G.—Distillation Analyses of Foreign Crude Oils, The Oil and Gas Journal, December 31, 1936; January 7, 21 and 28, 1937.

2. Willson, C. O.—The Oil and Gas Journal, page 194, December 29, 1945.

3. Kraemer and Lane—Properties of Typical Crude Oils from Fields of the Eastern Hemisphere, U. S. Bureau of Mines, Bulletin 401, 1937.

The major fields or kinds of oils are Masjid-i-Sulaiman, Haft Kel, Agha Jari, and Gach Saran. The characteristics of these crude oils are indicated in Table 1. In general the oils are similar to intermediate or mixed-base crude oils. They contain considerable sulfur and the large amount of gas produced with the oils may contain as much as 10 per cent by volume of hydrogen sulfide. Obviously, the sulfur must be removed in preparing commercial products. Egloff shows octane numbers of 68 for light gasoline (249° F. end point) and 38 for naphtha (265 i.b.p. and 406 e.p.).

The customary summary data of the Bureau of Mines for Masjid-i-Sulaiman and Haft-Kel crude oils are:

	Per cent	A.P.I.	Vis.
Light gasoline to 212° F.	8.8-10.9	73.6-76.0	.....
Total gaso. and naph. to 392° F.	32.3-34.8	58.9-60.8	.....
Kero. distillate	10.5-17.5	42.8-44.3	.....
Gas oil	9.6-16.0	33.8-36.4	.....
Nonviscous lube	9.8-10.6	27.0-32.1	50-100
Med. lube	6.7- 7.6	24.5-27.1	100-200
Residuum	21.2-22.6	13.6-14.4	.....
Loss	0.1- 0.8	.....	.....

Blending of Very Low Viscosity Materials

Can you suggest a method of estimating the viscosity of blends of the fluids found in oil reservoirs? The charts in your Petroleum Refinery Engineering go down to only 40 seconds Universal Saybolt and we need to go down to one centistoke or lower. —R. H.

NO experimental data seem to be available about such stocks but it would be expected that any of the conventional charts would work reasonably well. Charts that are stated in terms of Universal Saybolt viscosity do not show viscosities lower than about 40 seconds because the Saybolt equipment does not operate satisfactorily at low times of efflux. Blending charts in terms of kinematic viscosity can be extended to almost any range and hence A.S.T.M. Chart D (American Society for Testing Materials, 260 South Broad Street, Philadelphia) which is described in Standard D341, is suggested. It covers the range of 0.4 to 100 centistokes. Although it is a viscosity-temperature chart, the temperature range of 0° to 100° F. may be used as a percentage scale. The zero line is used for 100 per cent light component and the 100 line is used for 100 per cent of the heavy component. A straight line connecting these two points indicates the viscosity of any percentage blend.

A.S.T.M.-D-341 does not state that the kinematic viscosity charts can be used as outlined above but there is reason to believe that the kind of viscosity unit will not alter the blending relationship. Nevertheless, a partial check was made by taking viscosity blending data on 100-1,000 viscosity (Saybolt) mixtures, and 40-3,000 Viscosity Saybolt mixtures. The Saybolt viscosities of such blends were converted to kinematic viscosity by means of the following formula, which was taken from Questions on Technology, page 40, July 3, 1941, The Oil and Gas Journal:

$$\frac{Z}{S} = .22T - \frac{135}{T}$$

in which Z is viscosity centipoises, S is specific gravity at the same temperature, and T is the Saybolt time in seconds. The values are shown in Tables 1 and 2.

TABLE 1—COMPARISON OF THE CRUDE OILS OF IRAN

	Masjid-i-Sulaiman		Haft Kel	Masjid-i-Sulaiman and Haft Kel		Agha Jari	Gach Saran
A.P.I.	37.8	37.8	36.6	37.8	37.6	36.2	32.5
Vis.-U. Say. at 100° F., sec.	39.0	38.0	39.0				
Sulfur, per cent	0.95	0.99	1.12	1.10	1.02	1.37	1.72
Pour point, °F.	10.0	5.0	5.0				
A.S.T.M. distillation:							
I.b.p., °F.				104	133	104	104
5 per cent				160	148	190	200
10 per cent				200	215	240	247
20 per cent				270	283	325	340
30 per cent				340	355	414	440
40 per cent				418		500	530
50 per cent				496	521	572	
70 per cent					687		
90 per cent					753		
Bureau of Mines Distillation:							
Up to 122° F., per cent	1.5	1.8	1.5				
Up to 167° F., per cent	4.5	6.3	4.3				
Up to 212° F., per cent	9.2	10.9	8.8				
Up to 257° F., per cent	15.4	17.2	15.1				
Up to 302° F., per cent	21.3	23.5	22.2				
Up to 347° F., per cent	27.1	29.4	27.8				
Up to 392° F., per cent	32.3	34.8	33.2				
Up to 437° F., per cent	38.0	39.7	38.6				
Up to 482° F., per cent	43.1	45.3	44.1				
Up to 527° F., per cent	49.8	52.1	51.5				
Up to *585° F., per cent	53.8	55.8	54.1				
Up to *638° F., per cent	60.1	61.9	60.7				
Up to *685° F., per cent	65.8	67.4	66.3				
Up to *738° F., per cent	70.7	72.5	71.4				
Up to *782° F., per cent	76.6	78.7	77.3				

*Approximate. Converted from 40 to 760 mm.

TABLE 1—100-1,000 SAYBOLT VISCOSITY BLENDS

%	Saybolt viscosity Charts A or B	Kinematic viscosity Expected	Kinematic viscosity Chart C
0	100	20.65	20.65
10	120	25.3	25.3
50	280	61.1	61.1
90	770	169.2	169.2
100	1,000	219.9	219.9

TABLE 2—SAYBOLT VISCOSITY BLENDS, 40-3,000 SECONDS

%	Saybolt viscosity Charts A or B	Kinematic viscosity Expected	Kinematic viscosity Chart C
0	40	5.42	5.42
10	46	7.16	7.16
50	160	34.36	33.0
90	1,480	325.9	326.0
100	3,000	660.0	660.0

Note that Chart C was used rather than Chart D because no low-viscosity blending data were available. Only the 50-50 mixture of Table 2 fails to check, and this is such a severe test that it would seem that the use of the A.S.T.M. kinematic Charts C and D is satisfactory.

Corrosion

In High-Pressure Gas-Condensate Wells

*by H. Arthur Carlson**

THE latest and apparently one of the most technically difficult problems in corrosion has arisen in the operation of high-pressure gas-condensate wells. This problem was first publicly described by Bacon and Brown[1] before the N.G.A.A. in April 1943. They first noted corrosion in the Opelika field, Texas, in September 1942. Since then, the petroleum industry has realized the widespread existence of corrosion in high-pressure gas-condensate fields.

In addition to being very expensive, the corrosion of equipment in high-pressure gas-condensate fields offers a definite hazard to property and personnel. Pressures are from 1,500 psi. to as high as 6,500 psi.

It is now difficult to follow the recent voluminous technical literature relating to corrosion in high-pressure gas-condensate wells. A review of this literature reveals there is still a lack of fundamental data on the effect of certain factors and indicates a definite need for correlation of data. Much of the existing data should be further checked. Purpose of this report is to correlate and summarize the work that has been done so as to aid in planning future work.

NO single factor in either material or environment is apparently responsible for the variety of corrosion phenomena observed in the operation of gas-condensate wells. Corrosion occurs in well equipment where temperature and pressure conditions permit condensation of water. The presence of carbon dioxide in the gas in combination with the high pressure involved, indicates that the condensed water has low pH while it is under pressure.

Acidity of the well water.—Corrosion in gas-condensate wells is believed to be of the acid-attack type, or the reaction of iron with the hydrogen ion. Variations in surface finish, impurities, composition of the metal, velocity, and temperature of the corroding solution are of importance in the acid zone due to the evolution of hydrogen gas. Where a large volume of fluid continually flows over the metal, such as occurs in the gas-condensate wells, the hydrogen gas formed is carried away in solution to such an extent as to maintain a rapid rate of corrosion.

The hydrogen ion activity is the single controlling factor in the absence of modifying effects. It is determined by the concentration of acids dissolved in the water, the nature of the acids, the occurrence of natural inhibitors, the buffering effects of other dissolved electrolytes on the ionization of those acids, and upon the temperature and pressure conditions.

Since the total available acidity of the solution and not the pH determine hydrogen gas evolution, a carbon dioxide solution with a pH of 5.5 will show accelerated corrosion.[2] The pH of solutions of carbon dioxide gas at pressures of 40 to 400 psi. determined by Moore and Buchanan[3] show that the acidity from this source, namely a pH of 3.4 to 3.3, is sufficiently high to accelerate corrosion. Their data also gives the pH of carbon dioxide solution with carbon dioxide gas at pressures greater than one atmosphere as less than 3.7.

X-ray diffraction analysis of the corrosion product of a gas-condensate well showed it to be largely siderite ($FeCO_3$). That the corrosion product is iron carbonate demonstrates the large part that carbon dioxide plays in the corrosion process. Rapid corrosion would be expected if hydrogen sulfide is present in the well. Very few gas-condensate wells have hydrogen sulfide present, however.

Meraul states[4] that organic acids are the principal cause of the corrosion. However, experiments made at Battelle Memorial Institute indicate:

1. That propionic acid alone is much less corrosive to steel than carbon dioxide.
2. That in the presence of carbon dioxide, fatty acids in concentrations encountered in the field (500 p.p.m.) have no appreciable effect on the corrosion rate.
3. That carbon dioxide is the aggressive corrodent in these mixtures. Formic, acetic, propionic, n-butyric, and n-valeric acid have been reported in samples of gas-condensate well water, as well as small amounts of phenol.

It has been shown[5] recently that the presence of appreciable concentrations of organic acids in well-head water samples do not necessarily indicate a corrosive well. Recent investigations by Hackerman[6] indicate 15 to 20 times as much acidic material in the hydrocarbon liquid phase from a noncorrosive well as in that from a corrosive well. He believes that the lack of corrosive attack is due to the presence of a naturally occurring inhibitor, probably naphthenic acids, that is primarily associated with the liquid hydrocarbon phase. The hydrogen formed from acid corrosion would be less than 0.003 per cent by volume in a gas sample if a well was highly corrosive, therefore it is impracticable to test for hydrogen. This is based on the assumption that a corrosive well produces 500 p.p.m. of iron and that 1 bbl. of water is produced per million cubic feet of gas.

Effect of temperature and pressure.—The effects of increase in temperature are:

1. It facilitates corrosion by permitting the more rapid evolution of hydrogen gas;
2. It increases the electric conductivity of electrolytes and in this way produces greater localization of corrosion;
3. It lessens the solubility of gases in water;
4. It may increase the solubility of the corrosion product;
5. It may cause the precipitation of protective coatings, such as well waters containing calcium sulfate and calcium carbonate.

An increase in pressure increases the carbon dioxide solubility and also the rate of solution, thereby lowering the pH of the solution and increasing corrosive attack.

Velocity and turbulence.—The effect of velocity is usually to increase corrosion because of such factors as the following:

1. The fluid film adjacent to the metal is thinned down and diffusion of the corroding agent into the metal surface is more rapid;

*Phillips Petroleum Co.

2. Protective films on the metal surface are frequently removed by turbulence;

3. It becomes easier for the products of corrosion to diffuse away from the metal;

4. If the liquid carries gas bubbles or solid particles, it may result in erosion of the metal surface.

If the motion of the solution in contact with the surface is not uniform, the area subjected to the higher velocity becomes anodic with local solution of the metal. Dr. Harry Power of University of Texas and others believe that restricted velocity and turbulence increases cavitation (collapse of bubbles in the gas stream). Turbulence may be caused by a change in direction of the flowing liquid.

Metal-ion concentration cells.—Concentration cells of the metal-ion type may be associated with differences in velocity between two points on a metallic surface. The metal ions in the corrosion product may be removed continuously at one point, while they may accumulate at another. Metal-ion concentration cells are an important factor in corrosion of metals in acid, and may account in part for the irregular corrosion observed in gas-condensate wells.

Nature and concentration of dissolved substances.—The presence of dissolved substances affects corrosion by influencing the rate of solution, the solubility, and the rate of diffusion of the corroding agent. Dissolved substances also influence the conductivity of the solution.

It has been suggested that a natural inhibitor or buffer may be present in some wells to retard or suppress corrosion. Analysis of a water sample of the Phillips Petroleum Co. 1 Triangle showed sodium borate to be present. It has been shown by Shipley[7] that the system $CaSO_4$-$CaCO_3$-CO_2 and H_2O has a strong buffer action at a pH of 5.1. Such a solution should still evolve hydrogen and be corrosive, although at a slower rate of reaction.

Salt brines may reduce the corrosion rate by decreasing the carbon dioxide solubility and thus lowering the acidity.

Electrostatic discharges in the fluid.—Spray electrification is said to be due to the rupture of the electric double layer at the surface of the liquid. It is observed when very fine droplets are formed from larger droplets, such as in turbulence. The larger droplets are positive, and the smaller-than-mist size droplets carry the negative charge.

It was thought that if charges of sufficient magnitude were present, a current might be set up which would be a factor in corrosion in gas-condensate wells. Battelle Memorial Institute has constructed an instrument to measure electrical charges on droplets in the flow stream, and it has been tested on one well. The Pyrex glass cone insulated electrode was built to withstand a pressure of 8,000 psi. The current flowing from the collector plate was grounded through a resistor of known value. The voltage drop across this resistor was measured by a potentiometer.

The electrostatic charge measurements made on the 1 Tullos, Opelika field, Texas, definitely showed that charges do exist in the gas stream of a flowing well when measurements were made immediately downstream from a partially closed valve. The charge was negative; in other words, a current flowed from the plate into the gas stream. This current flowed in the right direction to cause corrosion. The currents measured were much too small to cause corrosion. The current was zero when the well was shut in and also under full flow. It may be concluded that the negative charge collected by the electrode came from negatively charged droplets of condensate. This charge would be greater at points in the gas stream where conditions were favorable for the formation of condensate droplets. A condition of turbulence could cause more condensate to strike at one point. The current would leave the pipe wall at the point where the most droplets hit and corrosion would take place at this point.

Many more measurements made under a variety of conditions will be required to establish the possible significance of the measured currents with respect to equipment corrosion.

Physical and chemical nature of the metal: Protective films.—Stress in the metal causes localized corrosion. Such corrosion has been noted in gas-condensate equipment, namely the Cotton Valley Field. There is usually some potential difference between strain and unstrained metal with the result that there is a tendency for localized corrosion.

Dissimilarity in the chemical composition of metals in contact with each other in an electrolytic solution sets up a difference in potential and thus may accelerate corrosion locally.

Holmberg[8] calls attention to the effect of variations at the surface and in the metal.

In most cases in the acid range, the protection afforded by films is slight. It is believed, however, that certain wells produce fluids containing polar materials which inhibit corrosion; for example, the higher organic acids with their carboxyl groups oriented toward the metal while the hydrocarbon portion of the molecule is oriented away from the metal which is condensate wettable.

Prevention and Control of Corrosion

Suitable corrosion-resistant alloys.—Low-alloy steels are not satisfactorily immune to acid corrosion. Laboratory tests by the U. S. Bureau of Mines and by Battelle Memorial Institute show a 5 per cent Cr steel in carbon dioxide and water to be less resistant than a low carbon mild steel under the same condition. Similar experiments with low Ni steels show that they are also subjected to severe corrosion. A 12 per cent Cr steel showed excellent resistance in carbon dioxide and water at 80° and 100° C.

The use of proper alloys, probably high nickel or high chromium content will resist acid corrosion, although a high chromium alloy may be attacked due to the chloride present in an acid solution.

Monel metal, yellow brass, and various bronzes found in valves have shown satisfactory resistance to corrosion.

Inhibitors.—The introduction of small amounts of film-producing materials into the fluid stream presents an effective means of corrosion control. As previously mentioned the higher organic acids may form films, and it may be possible to prevent corrosion by the use of these acids.

The use of sodium chromate has proven highly successful as an inhibitor of gas-condensate well corrosion in a number of fields where it has been tried. The chromate probably forms some protective film causing the metal to become passivated. It has been shown that chlorides tend to destroy the passivating effect of the chromate. Therefore, a higher concentration of chromate is required to render the metal passive in the presence of chloride.

Battelle Memorial Institute is conducting laboratory tests on a number of samples of commercial inhibitors, which have been successfully employed in protective oils, pickling baths, and other corrosion applications. Most of the tests have been carried out with distilled water saturated with 2 per cent carbon dioxide and 98 per cent nitrogen at 200° F. and 2,400 psi. Dr. Pray of Battelle has stressed the need for a limited number of actual well tests in the field with the inhibitors which seems most promising in the laboratory.

Laboratory tests by Battelle indicate that sodium dichromate is an extremely effective inhibitor. However, they report pitting of the metal when low concentrations are used, suggesting that, if insufficient chromate is used, the operation might become more hazardous because of perforations by pitting. Cocoamine was less effective as an inhibitor than sodium dichromate but it showed no pitting. Reilly No. 2 was a very effective inhibitor, as was Reilly No. 22 which reduced corrosion 85 per cent. Tall oil (high-molecular-weight fatty acids), lauric acid, and triethanolamine showed some inhibition, but not sufficient to be considered really effective. Oleic acid showed a slight reduction in corrosion rate. Tetraethylthiuram monosulfide reduced the pen-

etration rate about 30 per cent. The following materials do not inhibit corrosion to any worthwhile extent:

Alkaterge-C, Quinoline, Nopco 2098, Acid Inhibitor Pennsalt P40, Sulfonated Castor Oil-picoline, Washine A, Washine B, Rodine No. 101, and cocoanut oil fatty acids.

Stanolind Oil & Gas Co. has been injecting ammonia into its corrosive wells to neutralize the acidic water. On the basis of the reduction of iron in the water, they believe this treatment is effective.

Some wells do not lend themselves to injection of inhibitors since the annular space between the casing and tubing is packed off with mud. The continuous daily injection of inhibitors has been difficult to maintain in a number of tests that have been tried in the field due to mechanical difficulties and to failure to obtain chemicals. A number of wells have become plugged recently due to the use of sodium chromate and other inhibitors.

Suitable protective coatings. — The protection afforded by coatings in acidic waters is slight. Also, the rough usage that the material has to withstand, usually rules out protective coatings for gas-condensate well equipment. Morton of International Nickel Co. has pointed out that good hot-dipped and electroplated coatings cannot be obtained in tubing and that such coatings cannot be used on valve seats, valve plugs, etc., because of the tolerances involved.

A short nipple with an internal coating of synthetic resin (Lastiglass) failed in 9 months. Field tests with the corrosion resistant qualities of cement-lined pipe were reported by Bacon at the August 15, 1945, meeting of the N.G.A.A. high-pressure-gas corrosion research committee. Inspection of the cement lining indicated apparent erosion of the cement in the upstream end of the pipe. It is believed that carbon dioxide has a deleterious action on the cement as used.

The casing may be protected by setting a packer and filling the annular space between the casing and tubing with drilling mud. The addition of small quantities of alkali or an inhibitor to the mud will inhibit corrosion.

More attention should be given to acidizing wells, since serious corrosion problems may arise from improperly acidized wells.

Corrosion-Testing and Detection

Detection of corrosion.—Being internal, corrosion in gas-condensate wells presents a serious problem in detection as much of the equipment cannot be inspected by visual means without killing the well. Detection of corrosion thus requires the use of instruments, of which several have been developed recently. Short[9] describes such an instrument made by Halliburton Oil Well Co. which can be run inside the tubing strings under closed-in pressure to determine the magnitude of corrosion pits. The tool has been successfully used to survey over 50 Cotton Valley Operators Committee wells. An instrument developed by Sun[10] is capable of detecting both the location and the degree of corrosion in the tubing string.

The amount of iron produced in the well water is of some aid in detecting corrosion. These generalizations have been made: Corrosion will be almost negligible in wells showing less than 50 p.p.m. Wells showing iron concentrations of from 75 to 100 p.p.m. in the produced water should be watched for other signs of corrosion and wells showing iron contents in excess of 300 p.p.m. should be carefully inspected every 3 months. Recent data indicate this is not a reliable check.

Laboratory tests.—Laboratory corrosion tests are useful to:

1. Study the chemistry and mechanism of corrosion.
2. Determine the effect of organic acids, carbon dioxide, etc., on metals and alloys.
3. Determine the value of changes in composition or treatment in developing corrosion-resisting alloys.
4. Study the effectiveness of inhibitors.

Battelle Memorial Institute and the U. S. Bureau of Mines have studied Items 2, 3, and 4 in the laboratory. Dr. Norman Hackerman and D. A. Shock of the University of Texas are studying the chemistry and mechanism of corrosion. They are examining the surface film by microanalytical methods and by photomicrographs to establish its chemical and physical nature. From these studies, they will try to explain the mechanisms by which the changes take place and postulate methods for combating the corrosive action.

Their conclusions based on observation of two wells, one of which is corrosive and the other noncorrosive, are:

1. The coupon-testing procedure is a good method for evaluating corrosion type;
2. The 1 Tullos type corrosion is due to formation of a nonprotective coating which is conducive to pitting;
3. The 2 Tullos type noncorrosion is due to a self-established protective film;
4. The 2 Tullos type noncorrosive action is due to the presence of a hydrocarbon-soluble water-insoluble acid similar in nature to naphthenic acid;
5. The use of naphthenic acid or a similar acid compound has possibilities as an inhibitor.

Suggestions for Investigation and Research

Determine pH under well conditions.—All pH measurements of well water have been made after withdrawing the water from the gas-condensate well and have been made at atmospheric pressure and temperature. Gases absorbed by the water while under well pressure tend to escape as the pressure is reduced to atmospheric, causing a change in the pH. Therefore, it seems desirable to make pH measurements of the well water under well conditions. The pH of the well-head water can be determined colorimetrically by the use of a water trap equipped with a glass window. It will give some indication of the pH to be expected in the well.

Laboratory tests by Battelle seem to prove the feasibility of measuring pH at high pressures and temperatures with a combination of the quinhydrone and calomel electrodes. A glass electrode could probably be adapted to use at high pressures and temperatures also.

Determine dissolved CO_2 in H_2O under well conditions.—Carbon dioxide has been determined in the gas and in the hydrocarbon liquid but very few determinations have been made on the measurement of dissolved carbon dioxide in well water under well-head conditions of pressure and temperature. The amount of carbon dioxide dissolved in the water should be of aid in determining the acidity and therefore the corrosiveness of the fluid.

Laboratory studies. — The indications are that the pH of well water under well conditions of pressure and temperature is low enough to show accelerated corrosion. Undoubtedly there are controlling factors which influence the rate of chemical reaction. A study of the fluid-film behavior may aid in determining the controlling factor or factors. The collecting of data on water analyses, gas analyses, flow conditions, etc., should be continued. Valuable information may be obtained by making a complete analysis of a well water for organic acids, CO_2, buffers, natural inhibitors, etc., from a representative corrosive well and from a representative noncorrosive well. Since the natural inhibitors may be the higher organic acids, they are likely to be present in the hydrocarbon phase in a greater amount than in the water phase. Samples of the hydrocarbon fluid should be analyzed for possible natural occurring inhibitors. Examinations should be made of surface films formed by corrosion products, by natural occurring inhibitors and by commercial inhibitors. The examinations might include microanalytical methods, electron diffraction studies, X-ray analyses, and microscopic examination to establish the chemical and physical characteristics of the surface films.

Calculation of Corrosion Rates

Maximum penetration in inches per year is obtained by measuring the

maximum depth of corrosion and converting this value to a yearly basis.

Average penetration in inches per year (i.p.y.) represents the depth to which uniform corrosion would penetrate if a specimen were exposed to corrosion on one side only, 24 hours per day for 365 days. This unit has been adopted by the N.G.A.A. high-pressure-gas corrosion committee. It can be calculated by the following formula:

$$P = \frac{0.061,02W}{SAT}$$

where

P = the average penetration in inches per year
W = weight of metal removed in grams
A = the surface area exposed in square inches
S = the specific gravity of the metal
T = the duration of the test in years

Sometimes the corrosion rate is expressed as "milligrams per square decimeter per day" abbreviated mdd. or as "milligrams per square inch per day" abbreviated mid.

Mdd. units can be converted into penetration units by using the equation:

$$\text{mdd.} \times \frac{0.001,437}{\text{sp. gr.}} = \text{ipy}$$

The specific gravity for mild steel is 7.86 so we have:

$$0.000,183 \text{ mdd.} = \text{ipy}$$

The equation for converting mid. is:

$$\text{mid.} \times \frac{0.022,274}{\text{sp. gr.}} = \text{ipy}$$

or for mild steel it is:

$$0.002,84 \text{ mid.} = \text{ipy}$$

To obtain pounds per square foot per year multiply mdd. by 0.007,47.

Determination of Organic Acids

The following procedure is being used by Humble Oil & Refining Co. for electrometric titration of fatty acids in water.

About 60 to 75 cc. of water sample is put into a flask, a moderate excess of hydrated lime added, and boiled for a few minutes under a reflux condenser so that no volume is lost. It is then filtered and the filtrate cooled. Fifty cc. of the clear filtrate is placed in a flask fitted to accommodate calomel and glass electrodes, an air-driven stirrer, and a burette, with the entire assembly closed. The solution is titrated with standard hydrochloric acid of suitable concentration, usually 0.01N to 0.03N. The pH of the solution is determined after each addition of acid. The data are plotted on a graph and the end points selected graphically by the "tangent" method.

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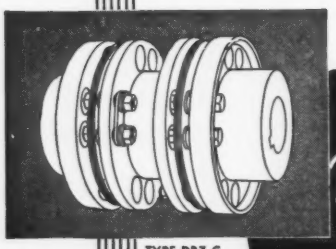

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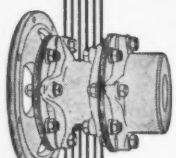

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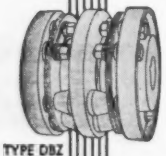

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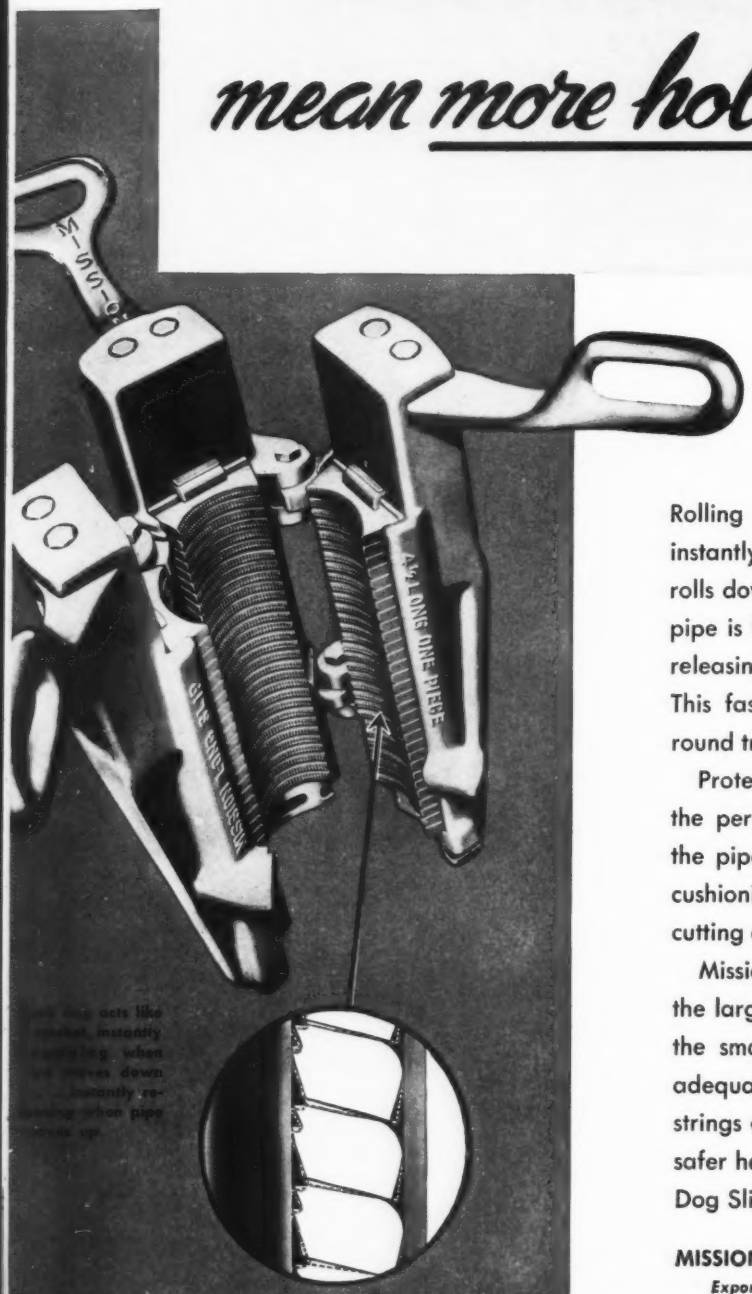

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$$K = \frac{\text{B.t.u.} \times \text{ft.}}{\text{sq. ft.} \times \text{hr.} \times \text{°F.}}$$

Example: Cork insulation 8-in. thick at wall temperatures of —50 and +80 will conduct in 4 hours through 60 sq. ft. of wall area:

$$.03 \times 4 \times 60 \times 130 \times 12/8$$

or 1,400 B.t.u.

TABLE 1—THERMAL CONDUCTIVITY OF REFINERY MATERIALS

(B.t.u.-ft./sq. ft.-hr.-°F.)

Lampblack	0.04	Sandy soil, dry, 24-in. cover	0.24-0.4
Coke	0.48	Sandy soil, moist, 24-in. cover	0.5-0.6
Cracking-coil coke	3.25	Sandy soil, soaked, 24-in. cover	1.1-1.3
Iron sulfide	4.10	Under river	2.0-2.5
Boiler scale (ave.)	1.43	Sandy soil, dry, 8-in. cover	0.6-0.7
Refined lube oil	0.08	Sandy soil, moist, 8-in. cover	1.2-2.4
Paraffin wax	0.14	Clay soil, dry, 24-in. cover	0.2-0.3
Asphalt	0.10	Clay soil, moist, 24-in. cover	0.4-0.6
Asphaltic road	0.42	Clay soil, wet, 24-in. cover	0.6-0.9
Concrete	0.44		
Cork	0.03		
Asbestos felt	0.12		
Wood pulp	0.025		
Magnesia	0.04		
Kapok	0.02-0.025		
Asbestos wool	0.03-0.04		
Jute fibres	0.02-0.035		

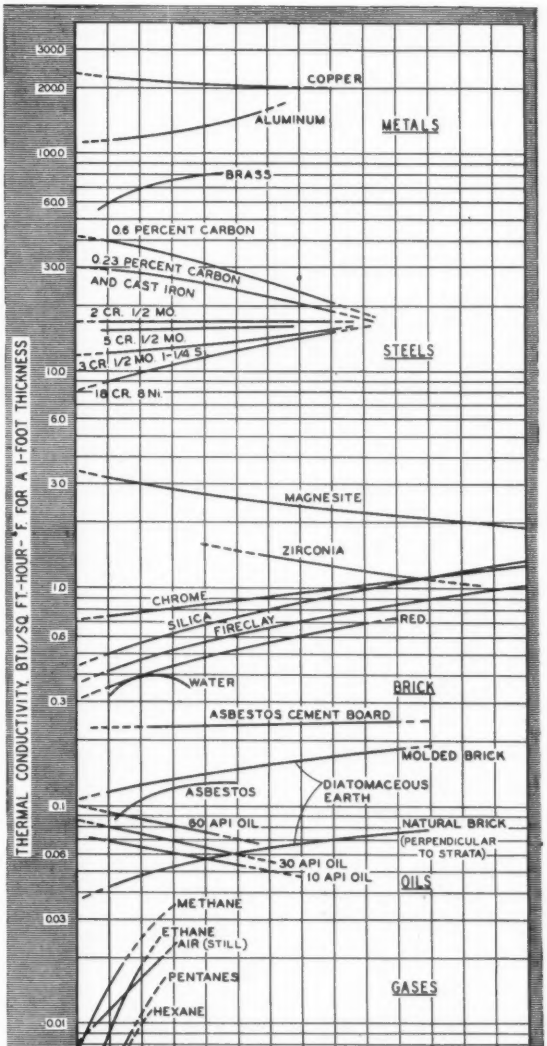
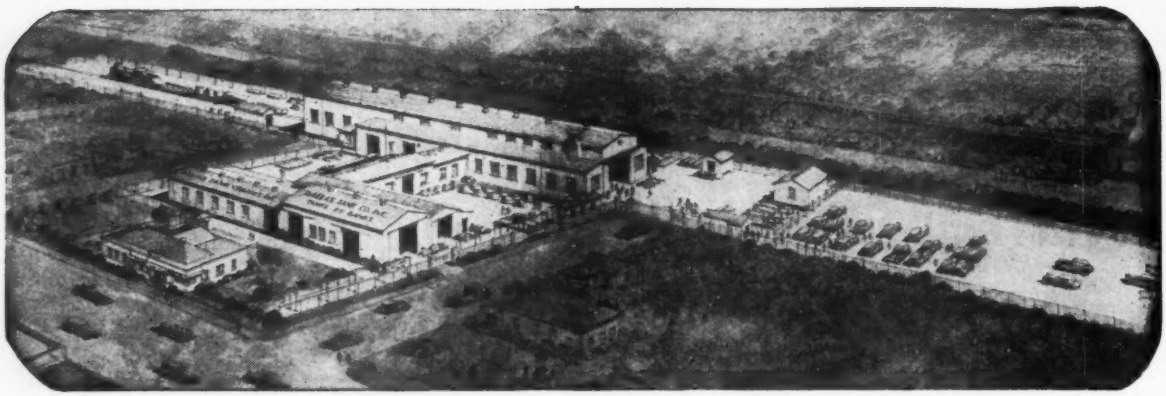


Fig. 1—Thermal conductivity as a function of temperature

No. 124 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa



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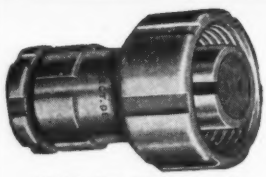

PLUG—Type W16-11-S-21 ¾
Two #12 Wires—socket insert

A new line of heavy duty multi-contact connectors for uses undersea, underground or where moisture conditions require thoroughly sealed fittings.

SPECIFICATIONS: Three shell sizes based on "AN" standard 16, 22 and 36. Nearly 50 different insert arrangements available. Watertight coupling and cable entry. Brass shell with bright nickel finish.

PLUG—Type W16-11P-22-¾
Two #12 Wires—pin insert

For further information, write Dept. L-164, Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.

CANNON ELECTRIC

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Cal.
Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto, Canada

Aeration of Water

MAJOR purposes for which aeration of water is used are:

Removal of undesirable gases such as hydrogen sulfide, free carbon dioxide, and excess chlorine. Removal of odors due to volatile materials or those that vaporize easily. Aromatic, grassy and fishy odors of volatile essential oils from various microscopic organisms, when present in water, can be greatly reduced by aeration. Aeration also removes taste and odors due to dead algae by sweeping out the gases of decomposition but does not actually destroy algae except the more fragile forms. Absorption of oxygen may be used to effect the oxidation and precipitation of iron and manganese.

Chemistry Involved

Removal of gases by aeration follows Henry's Law which in brief states that the solubility of a gas in water is directly proportional to its partial pressure in the surrounding atmosphere. At 20° C. and at sea level, 1 liter of water in equilibrium with the atmosphere will hold in solution approximately 15.8 p.p.m. nitrogen, 9.4 p.p.m. oxygen and 0.5 p.p.m. carbon dioxide. Both hydrogen sulfide and carbon dioxide are relatively soluble in water, one volume of water in contact with the latter gas at 18° C. dissolving approximately one volume of the gas. The partial pressure of each of these gases in the normal atmosphere, however, is practically "zero" so that the establishment of a state of equilibrium between water and air will result in the saturation of the water with nitrogen and oxygen and practically complete elimination of hydrogen sulfide and carbon dioxide from the water.

The basic fundamental in securing removal of these gases by aeration is the establishment of a state of equilibrium between the gases in the water and the gases in the surrounding atmosphere.

The efficiency of this process is dependent on several factors. These are as follows:

The greater the concentration of a gas in water and the smaller its concentration in air, the more rapid is its removal; and conversely the greater the concentration of a gas in air and the smaller its concentration in water, the more rapid is its solution.

The greater the surface of water exposed to the air in a unit of time the more effective is the removal of gases from the water and the absorption of gases from the air.

The greater the change of air in contact with the water, the more rapidly are gases removed from the water and absorbed from the air.

The greater the time of aeration, the more completely is equilibrium established.

The greater the temperature at which the process is carried out the more quickly is equilibrium attained.

While aeration effects removal of certain dissolved gases from water, it also serves to saturate the water with oxygen. Where aeration is employed for removal of iron and manganese, the oxygen added to the water by aeration, enters into the chemical oxidation of the iron and manganese, removal of carbon dioxide increases the pH value, and precipitation occurs as ferric hydroxide and hydrated manganese dioxide.

Equipment Employed

Aeration is primarily a mechanical process and two general methods are employed:

First of these consists in pumping air into water by means of perforated pipes, strainers, porous plates, or tubes. For maximum efficiency with this type of air diffusion, the distribution must be uniform from the entire surface of a plate or the entire length of a tube as well as uniform throughout the aeration tank. Aeration by diffusion is quite efficient inasmuch as a fine bubble of air rising up through the water will continuously be exposed to fresh liquid surfaces whereas in falling water aeration a falling drop might be expected to have a thin air film but a thick water film. Velocity of air bubbles rising through water is considerably slower than the velocity of free falling drops of water, thereby giving a longer period of contact.

In the conditioning of boiler feed water or in the treatment of make-up water for cooling systems, aeration is frequently employed for the removal of carbon dioxide from water following acidification with sulfuric acid. Such acid treatment may be employed in the case of boiler feed water for the purpose of reducing the alkalinity of a sodium zeolite effluent and thereby reducing carryover tendencies. It is also applied to a sodium zeolite effluent to reduce the free carbon dioxide content of steam or to reduce alkalinities and thus help to establish A.S.M.E. recommended sulfate carbonate ratios of the boiler water. In the case of cooling-water systems such acid treatment may be employed to convert a scale forming salt such as calcium bicarbonate to a form such as calcium sulfate which is not scale forming at the concentrations encountered. Dependent upon the physical characteristics of the individual system, release of carbon dioxide may be effected in the cooling tower or by air diffusion from the make-up water.

For such purposes, an aeration tank is constructed so as to provide a minimum of 15 to 20 minutes retention. The tank is properly baffled and diffuser units located so that intimate contact of air and water are secured and "dead spots" are eliminated. Diffusers are located approximately 8 to 10 ft. below the surface of the water and compressed air provided at sufficient pressure to overcome this head.

Air requirements by the diffusion method vary considerably, usually over a range of 0.005 to 0.20 cu. ft. of air per gallon of water treated. The lower requirement pertains to odor removal while the higher figure is necessary for the efficient elimination of carbon dioxide and hydrogen sulfide.

Second general method for securing aeration consists in exposing the water to the atmosphere in the form of thin sheets, small streams, drops or spray. This is effected by one of these means:

Simple exposure to air; vertical risers; flowing over weirs or cascades by steps; trickling devices; spray nozzles; air lift; forced-draft aerators.

Aeration by means of spray nozzles is one of the most efficient and common methods employed. Nozzle pressure required varies from 2.5 to 12 psi. A relatively large area is required although this is, of course, dependent on the nozzle grouping. Existing installations vary from 167 to 1,770 sq. ft. per million gallons per day. Nozzle output varies from 44 to 175 g.p.m. Windage loss is quite high and louvered fences usually house an installation.

This material is from the Betz Handbook for Industrial Water Conditioning, written and published by W. H. and L. D. Betz, consulting engineers, Philadelphia.

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We're talking about Driocel . . . a desiccant made from natural bauxite. The first, vital step in the building of its amazing efficiency is the selective procurement of the most ideal ore. Literally, then, we do get "down to earth" . . . with rigid control right at our mines.

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Driocel is successfully drying hydro-carbon liquids and gases, liquid organic chemicals, compressed air, electrical oils, hydrogen, hydrogen sulfide, etc. We'll welcome the opportunity to get "down to earth" on *your* drying problems. Address: Attapulgus Clay Company (Exclusive Sales Agent), Dept. G, 260 So. Broad Street, Phila. 1, Pa.

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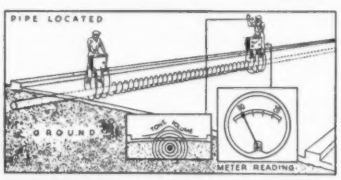
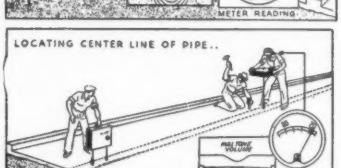
M-SCOPE BURIED PIPE FINDER and LEAK DETECTOR





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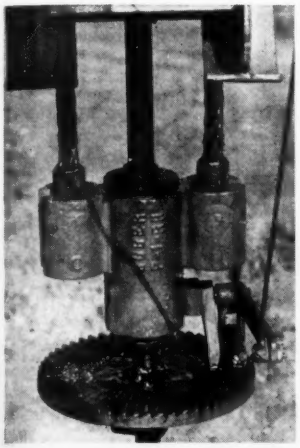
OIL AND GAS EQUIPMENT Digest

IT'S NEW ✓ CHECK IT

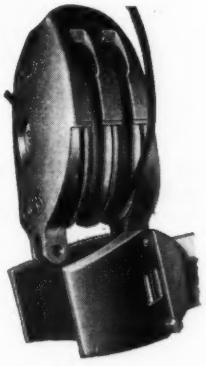
by John M. Spears



(1) NEW PARAFFIN ELIMINATOR. Frequent well servicings due to paraffin accumulations are eliminated by new mechanical scraper. The regular rod string of the well is equipped with "pressed on" scrapers, and the rod string is revolved as it is reciprocated. Each sucker rod is placed in a pneumatic jig equipped with pressure arms to force three U-shaped clips around the rod and to 1/32-in. of surface of 26-in scraper. To rotate rod string, a steel hanger body is attached to bridle of unit's or jack's head. The rod string thus is rotated by ratchet levers attached to hanger body which engage teeth on the horizontal toothed table flanged directly under hanger. Actuating lever is moved by a flexible cable attached to walking beam. *J. M. Huber Corp.*

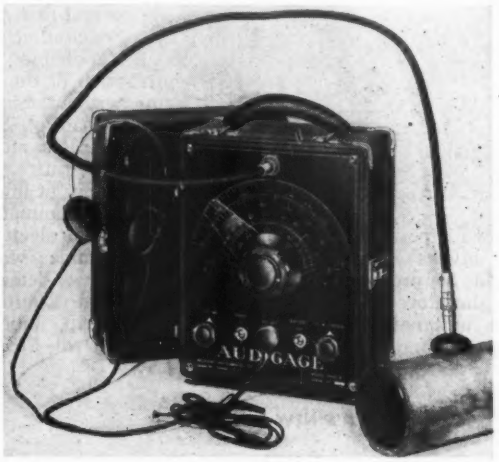
IT'S NEW ✓ CHECK IT

(2) QUICK-OPENING UNITIZED BLOCK combines traveling block and a free-swiveling hook or link adapter connector for portable rig and well-servicing operations. New hinged construction simplifies rigging up. Instead of reeving lines through the block or removing the guard to expose sheaves, a pin is pulled, the block is opened, and the lines laid in place. When the block is closed, the pin is replaced and block is ready for use. *Baash-Ross Tool Co.*



IT'S NEW ✓ CHECK IT

(3) AUDIGAGE THICKNESS GAGE is a portable, self-contained instrument which measures thickness of pipes, storage tanks, pressure vessels, etc. Gage utilizes a crystal-type gage head powered by a frequency-modulated electronic oscillator. When vibrating crystal is applied



to wall surface, mechanical resonance of wall thickness can be produced directly below crystal. Fundamental frequency at which wall section resonates is directly proportional to velocity of sound in material, and inversely proportional to thickness. Wall thickness will also resonate at all harmonics of fundamental frequency. Audigage provides a means whereby audible signals are produced corresponding to harmonic resonance. Frequency difference between any two adjacent audible signals, as read on tuning dial, is readily converted into wall thickness on a concentric thickness scale. Instrument provides other information than thickness alone. Character of the audible indications varies with several factors, such as kind of material, condition of reflecting surface, back-up liquids, process scale, etc. These factors provide useful information, but do not influence accuracy of thickness measurement. *Branson Industruments, Inc.*

IT'S NEW ✓ CHECK IT

(4) NEW ELECTRO-HYDRAULIC CONTROL system is adaptable for refineries, oil-well drilling rigs, and plants

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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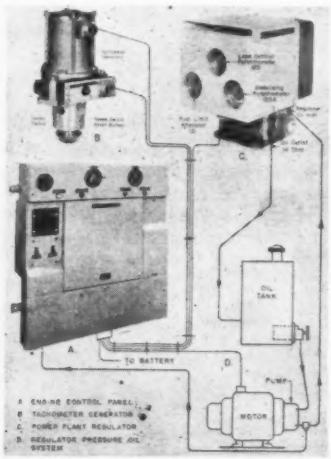
where diesel-electric drivers are employed. Speed measurement is performed by engine-driven a.-c. tachometer generator whose output voltage is proportional to speed. Speed is maintained at preset values by feeding the speed indication to a hydraulic servo-mechanism which controls the engine fuel and generator excitation, and makes possible full utilization of the engine without danger of overloading. System operates stably over wide range, and permits use of lowest speed commensurate with power requirements. Feedback from electrical load allows control to anticipate speed changes which would be produced by changes in generator demand, and therefore minimizes transient regulation. Equipped with automatic switches for overspeed trip, lube-oil pressure, and maximum temperature. *General Electric Co.*



IT'S NEW CHECK IT

(5) HEAVY-DUTY THREAD PROTECTORS. Made from tough, fabric-reinforced PRX special rubber. Units absorb shock and shield threads during handling. Made in a variety of sizes for both pin end and box end, standard A.P.I. right and left-hand threads in regular and full-hole types. Easily applied and removed for reuse. Vent and drainage holes permit fluid to flow out but the threads are sealed from exposure and damage. Protectors are used on drill pipe and all heavy items such as drill collars, kelly subs, fishing tools, reamers, and bits. *Patterson-Ballagh Division, Byron Jackson Co.*

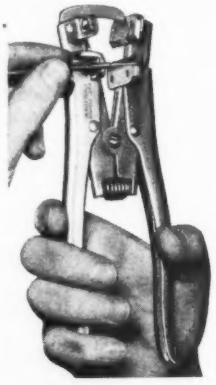
IT'S NEW CHECK IT

(6) MORCO-THIAZOLE is a new development for the treatment of first, second, and third-degree burns. Cod liver oil 65 per cent, the active ingredient, supplies vitamins A and D in sufficient quantities to stimulate rapid rebuilding of epithelium. The inclusion of sulfathiazole 5 per cent inhibits infection and minimizes danger of scars and contractures. Jar small enough to fit in automobile compartment, safety kits, etc. *Archer-Taylor Co.*

IT'S NEW CHECK IT

(7) PLASTIC-COATED DRILL PIPE. Resists corrosion often encountered in oil-well drilling. Coating is impervious to oil and water, resists chemical attack, and remains chemically stable itself. Will withstand 400° F. temperatures, resist mild abrasion and not become brittle or flake off. In construction, drill pipe first is shot-blasted on the inside and then upended in a rack. The liquid plastic is forced up the inside of pipe until it has reached the top. After a short drying period at normal temperature, the pipe is placed in an oven and the plastic coating is baked on in four successive coatings. *Spang-Chalfant Division, The National Supply Co.*

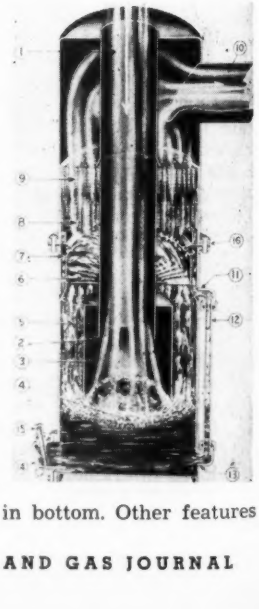
IT'S NEW CHECK IT



(8) NEW WIRE STRIPPER. Developed for every-day electrical needs in field installations, construction work, plant wiring, etc. Tool strips No. 10 to No. 22 solid or standard wires. Simple and easy to use as a pair of pliers. Clamps wire, cuts insulation, and strips it in one operation, without nicking wire or cutting the strands. Automatic feature prevents jamming of wires and strands. Pocket size. Blades are renewable. *Holub Industries, Inc.*

IT'S NEW CHECK IT

(9) WHIRLWIND OIL BATH AIR CLEANER includes visible means of determining oil circulation by gage glass. Oil-level adjustment made by raising oil-level regulator and adding oil until satisfactory flow is indicated in gage glass. Operation insures positive scrubbing action. After air passes down through center tube, and following initial impingement against oil in bottom of cleaner, it passes upward through coarse-mesh hardware cloth and carries considerable oil with it. Dust is caught in oil film coating on these wire strands and is washed away by circulating oil which is thrown out of oil stream by centrifugal action and passes to reservoir in bottom. Other features



include demountable construction, center tube inlet, and side outlet. *Continental Air Filters, Inc.*

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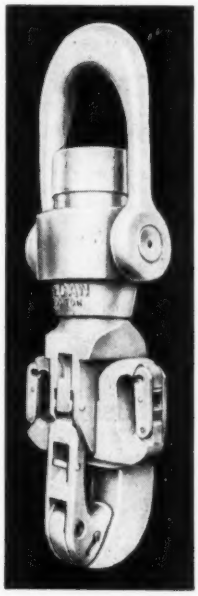
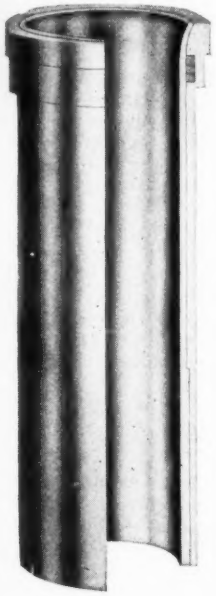


(10) COMBINATION CASING HOOK has special design of yoke sliding down and riding on hook bight. Bail attached to swivel allows hook to swing easily. New type antiswiveling mechanism permits 60° reverse rotation when in locked position, and four locking positions are incorporated. Includes a heavy spring for lifting swivel and kelly, and a combination of a heavy and light spring for running drill pipe. All latches are equipped with automatic locking devices and the main-hook latch closes and locks automatically whether load is picked up on the main-hook part or the elevator yoke. *Regan Forge & Engineering Co.*



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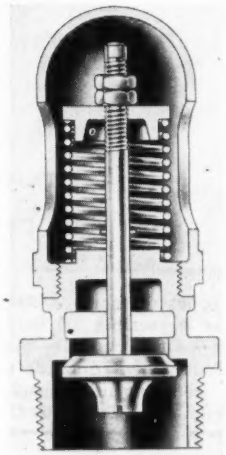
(11) RENEWABLE-SLEEVE PUMP LINER embodies a new and economical method of reclaiming pump liners by use of a specially designed liner sleeve. At upper end of liner is offset provided to hold oil-resistant, rubberized-duck hydraulic packing which protects the liner body against cutting effect of abrasive mud moving through pump. Liner sleeve, heat-treated to a surface hardness of 60-65 Rockwell, is pressed into liner body with a 150-ton hydraulic press. Tight fit between body and liner insures complete sealing of the packing. *Specialty Sales Service.*

IT'S NEW CHECK IT

(12) VACUUM BREAKER protects closed tanks, special piping systems, heating units, etc. Housing enclosing spring breaker prevents alteration of the setting through tampering or accidental bumps. Device prevents collapse by admitting air into the unit when the inside pressure becomes sub-atmospheric beyond a predetermined point. Single-seated, tight-closing, and of all-bronze construction. Stainless steel spring can be adjusted for a set absolute pressure. *Associated Valve & Engineering Co.*

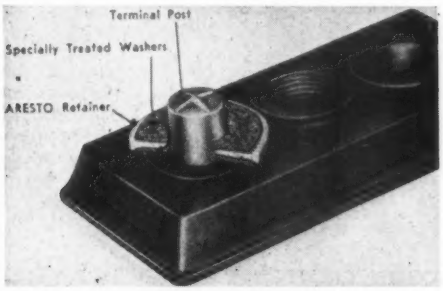


IT'S NEW CHECK IT

OIL AND GAS EQUIPMENT Digest

IT'S NEW CHECK IT

(13) ARESTO BATTERY PROTECTORS. Assures protection against corrosion for life of the battery. Consists of a metal retainer with two chemically treated wool washers, separated by a perforated web of the retainer. When motor is operating and generating heat of 110°

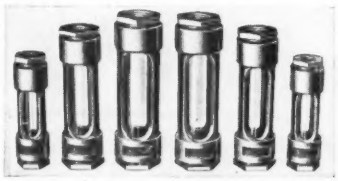


to 120° F., the chemical used in treating these washers tends to liquefy and acts as a corrosive preventive. In stopping the motor, a cooling effect takes place, congealing chemical composition to original state. Top washer acts as an additional reservoir to draw from in event there is an abnormal dissipation of chemical in lower washer. *Battery Supply Co., Inc.*

IT'S NEW CHECK IT

(14) STOP-FIRE EXTINGUISHER employs carbon dioxide with carbon tetrachloride for an effective chemical to put out fires. Shot as a fine spray, chemical is converted instantaneously into a heavy, fire-smothering gas. Oil, ether, gasoline, and electrical fires are blanketed and snuffed out in a matter of seconds. Fluid is effective indefinitely, and tank does not have to be refilled, except when used. Pressure gage attached to extinguisher indicates fluid pressure at all times. *Union Stop-Fire Corp.*

IT'S NEW CHECK IT



(15) FULL-VIEW FITTINGS, for line observation purposes, are compact units ranging in sizes from ½ in. I.P.S. to 1 in. Available for iron, brass, or stainless steel pipe lines, and constructed for safe operating pressures up to 200 psi. Glass is Pyrex on all standard fittings. *Jacoby-Trabox Corp.*

IT'S NEW CHECK IT

TRADE LITERATURE

(16) NEW INSULATION CHART. Handy reference guide assists in determining type and thickness of insulation for oil and gas industrial applications for temperatures from —300° to 2,800° F. Can be used by engineers and others to get a comparison of thickness required where more than one type of material is suited for a particular temperature range. *Armstrong Cork Co.*

IT'S NEW ✓ CHECK IT

(17) STEAM TRAPS. New book explains "How to Choose a Steam Trap." Gives tables, charts, formulas, and typical piping diagrams for steam trap installations. Also includes a complete description of super-silvertop, an improved inverted bucket trap. *The V. D. Anderson Co.*

IT'S NEW ✓ CHECK IT

(18) COCOON PROTECTIVE PACKAGING. A three-color bulletin describes plastic-packaging process used by armed forces to protect planes, ships, tanks, etc. Emphasizes application in machine and tool protection against rusting or deterioration. How it is applied and technical facts and figures included. *R. M. Hollingshead Corp.*

IT'S NEW ✓ CHECK IT

(19) CLEAN OIL. Pictorial publication is devoted to case histories of oil-purification equipment, covering specific applications on hydraulic equipment. Printed in two colors and well illustrated with pictures and engineering diagrams. *Honan-Crane Corp.*

IT'S NEW ✓ CHECK IT

(20) DRILLING MUD. Bulletin thoroughly covers Anhydrox for overcoming the contaminating effects of anhydrite and gypsum in drilling mud. Field and laboratory photographs included in 11 pages. Gives service engineers' test reports in tabulated form. *Baroid Sales Division, National Lead Co.*

IT'S NEW ✓ CHECK IT

(21) GAGES. Bulletin covers gages designed for oil industry. Features master gage for extreme pressure or heavy-duty service such as drilling, capping, pumping, piping, or refining. Also describes and illustrates mud pump, vapor-test, boiler, christmas tree, and general hydraulic gages. *Jas. P. Marsh Corp.*

IT'S NEW ✓ CHECK IT

(22) EARTH BORING MACHINE. New color folder features boring machine with hydraulic control to insure ease of operation and provide automatic regulation of cutting speed to suit texture of soil. Illustrated with photographs showing actual operation. *Jaques Power Saw Co.*

IT'S NEW ✓ CHECK IT

(23) VALVE INSTALLATION AND MAINTENANCE. New 20-page, 2-color brochure contains practical information on engine-valve problems, installation, and maintenance, helpful to operators and maintenance departments using valves, seats, and guides. Another section tells the story of valve manufacture, including upsetting and hot forging, heat treating, surface grinding, and final inspection. Liberally illustrated with photographs, table, and sketches. *Thompson Products, Inc.*

IT'S NEW ✓ CHECK IT

(24) PRESSURE LOSS IN STEAM LINES. Chart on pressure loss in steam lines reduces variables in determining pressure loss to flow in pounds per hour, specific volume, and size of pipe. Instructions on back explain and give examples of use. *Armstrong Machine Co.*

IT'S NEW ✓ CHECK IT

(25) MAGNESIUM PROTECTION. A five-page treatise on magnesium summarizes metal's fight against corrosion in underground pipe lines. Covers types of corrosion, the principle of cathodic protection, and how and where magnesium anodes may be installed. *Magnesium Division, The Dow Chemical Co.*

IT'S NEW ✓ CHECK IT

(26) ACID RESISTING FLANGED PIPE. Engineering and installation data on Duriron and Duriclor flanged pipes and fittings is contained in four-page bulletin. Lists advantages, limitations, dimensions, and available fittings. *The Duriron Co., Inc.*

IT'S NEW ✓ CHECK IT

(27) HYDRAULIC CONTROL HOSE. New catalog leaflet on high-pressure hose features the correct method for figuring the proper length for various bending radii of many sizes of hydraulic control hose. Construction features of product and method of manufacturing are discussed. *The B. F. Goodrich Co.*

IT'S NEW ✓ CHECK IT

(28) STAINLESS STEEL and its varied uses are covered by 26-page multicolored bulletin. Features description of modern oil well blowout control and use of blowout preventers. Includes color photographs and flow charts. *Allegheny Ludlum Steel Corp.*

IT'S NEW ✓ CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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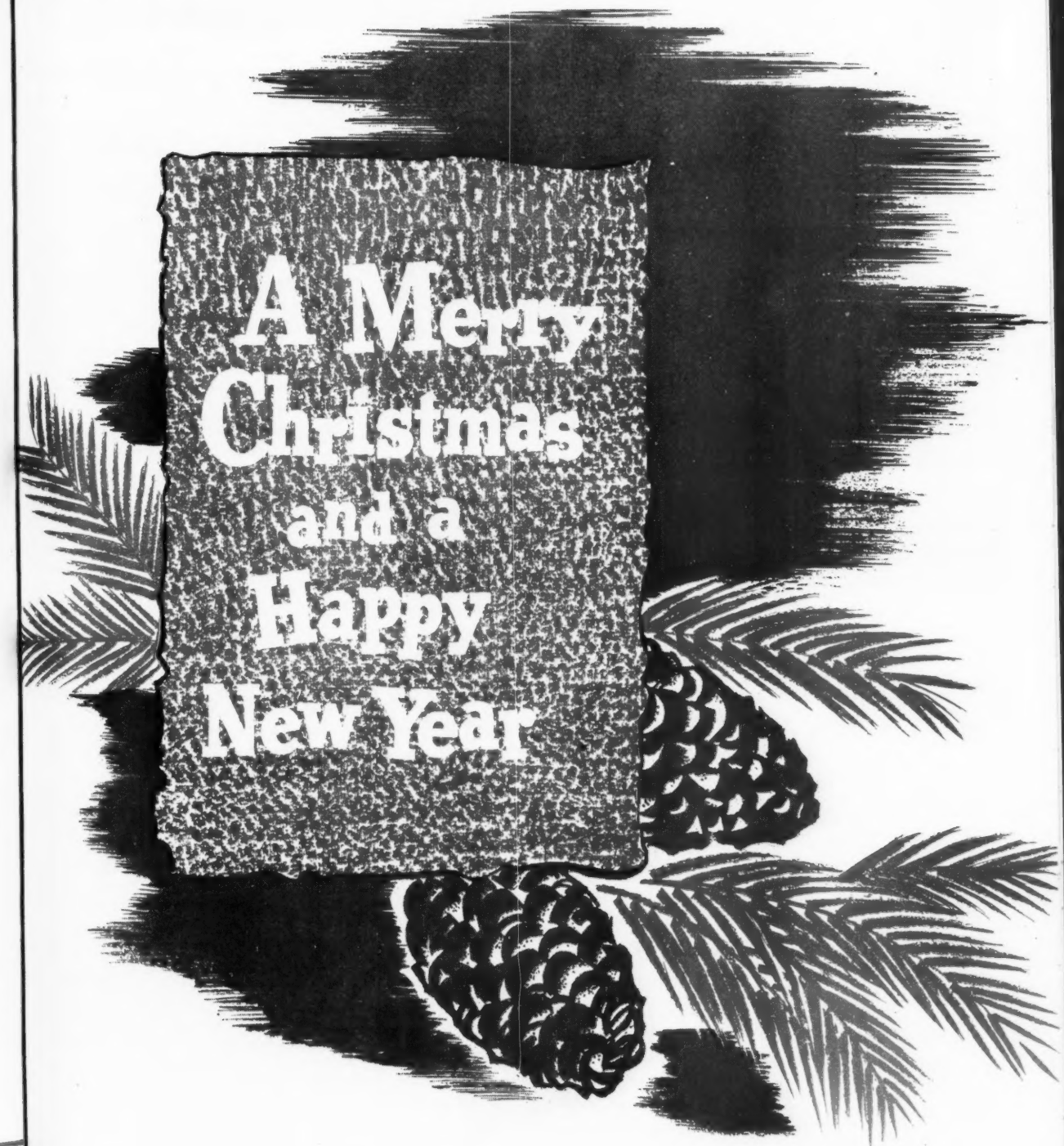
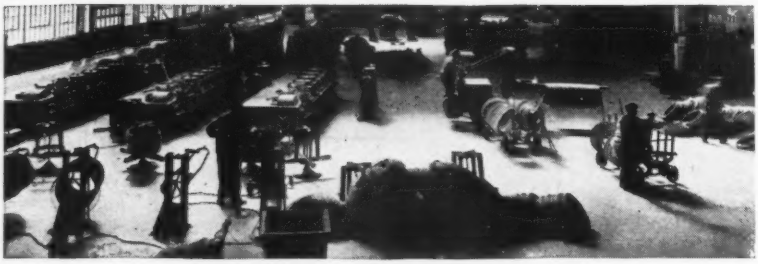


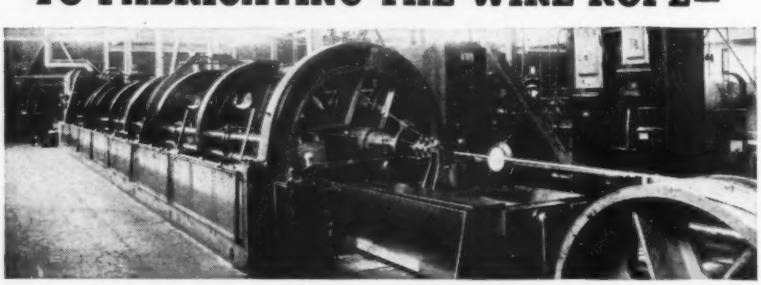
H C Smith Oil Tool Co.

FROM THE MAKING OF THE STEEL—

THROUGH PROCESSING THE WIRE—



TO FABRICATING THE WIRE ROPE—



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REFINING

Sunray Installs Desalting Units, Control System

Sunray Oil Corp. this week began installation of a new automatic-control system for the thermal cracking plant at its Allen, Okla., refinery.

Expected to be in full operation by February 1, the new board is 18 ft. long and 9 ft. high and includes more than 40 control items. It is expected to provide more uniform control of plant operations by reducing variables in temperatures, pressures, and flows.

Four 3,000-bbl. Petreco desalting units also are being installed at the Allen refinery to remove salt content from crude oil before it is received into the plant. F. L. Martin, vice president in charge of refining, said the units will greatly reduce costs by eliminating much corrosion of pipes, towers, pumps, tubing, and other equipment.

The refinery previously has used chemical agents to remove salt from oil. Sunray recently completed installation of similar desalting units at its Santa Maria, Calif., refinery.

Shell Announces New Apple-Drop Preventive

A new oil-base spray designed to delay the dropping of apples from orchard trees until fully ripened and until they can be picked has been announced by Shell Oil Co., Inc.

According to Shell officials, the spray delays dropping of the fruit from 10 days to 2 weeks or more after it normally would occur, allowing growers to spread picking over longer period, level labor-requirement peaks, reduce losses and obtain a fuller color in the fruit.

The spray contains an oil base which serves as a carrier for alpha-naphthalene acetic acid. It acts by delaying the development of a weakened condition at the ends of the stems where the apple is attached to the tree. Only a small amount of the hormone chemical is required to reduce dropping from 50 to as high as 80 per cent.

Mid-Continent Bright-Stock Production Shows Drop

Bright-stock production by 12 Mid-Continent refineries totaled 220,387 bbl. during October, a drop of 27,791 bbl. from the September figure of 247,178 bbl.

Figures released by the Western Petroleum Refiners Association showed a gain of 51,564 bbl. in viscous-neutral output with an October production of 382,202 bbl. against 330,638 produced in September.

Inventories of bright stocks dropped from 43,818 bbl. on September 30 to 140,171 bbl. on October 31, while viscous-neutral inventories fell from 234,662 bbl. to 212,157 bbl.

Eleven From A.P.I. Named in American Standards Group

NEW YORK.—Eleven members of the American Petroleum Institute have been named to the American Standards Association's committee Z-11 which handles specifications on lubricants and other petroleum products. Members are: D. E. Carr, Union Oil Co. of California; L. L. Davis, Continental Oil Co.; E. W. Dean,

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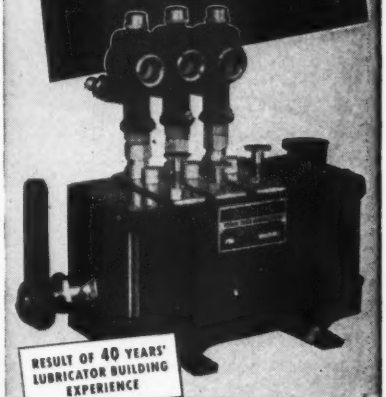
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LUBRICATOR DIVISION

Standard Oil Development Co.; N. P. Ferguson, Standard Oil Co. (Ohio); J. Bennett Hill, Sun Oil Co.; H. P. Hobart, Gulf Oil Corp.; A. E. Miller, Sinclair Refining Co.; J. S. Pfarr, Leonard Refineries, Inc., Alma, Mich.; C. F. Ramey, Standard Oil Co. of California; J. B. Rather, Socony-Vacuum Oil Co., Inc.; and L. C. Welch, Standard Oil Co. (Indiana).

Toluene Plant Surplus

WASHINGTON. — A toluene plant operated by Standard Oil Co. of New Jersey at Baton Rouge, La., has been declared surplus, the War Assets Administration announced last week. The plant was included in a group of wartime installations which WAA said would be processed for disposition after surveys and classification.

WAA Announces Sale Of Surplus Oil Products

WASHINGTON.—War Assets Administration this week announced it will sell 5,000,000 lb. of chlorinated paraffin, 2,000,000 gal. of xylidine and more than 8,000,000 gal. of hydraulic and recoil oil, first two items through competitive bidding and the last on a fixed-price basis. All are surplus war materials.

WAA officials said the chlorinated paraffin was used for water-proofing and flame-proofing tents and other canvas material. The xylidine was used as an additive to raise the octane rating of aviation gasoline, and the hydraulic oil was employed in hydraulic artillery mechanisms.

At the same time, the Maritime Commission announced the sale of seven tankers on which construction was suspended following the end of the war. They will be sold in their unfinished shape to the highest bidder. The ships are in the former yard of the St. Johns River Shipbuilding Corp., Jacksonville, Fla.

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Steel-Container Output Farther Behind Demand

Steel drums and all other metal containers still are in short supply and manufacturers who depend upon them to carry their finished or raw products may be forced to curtail production, according to the December report of the Civilian Production Administration.

Although 2,000,000 heavy steel drums were produced in September, against 1,700,000 in January, unfilled orders stood at 12,200,000, more than twice the January backlog figure and five times that at the end of 1941, the CPA reported. Light-drum production showed a slight decline between January and September, while unfilled orders increased from 1,800,000 in January to 2,200,000 in September, representing 3 months of production at the September rate of 739,000 units.

Producers' stocks, the report added, "have remained at levels that for all practical purposes are nonexistent."

Bureau of Mines Develops New Shale Assay Method

WASHINGTON.—An improved method of assaying oil shale which saves time, simplifies retorting, and recovers more oil has been developed by the Bureau of Mines, Dr. R. R. Sayers, bureau director, announced last week. The method is now being used at the bureau's new oil-shale research and development laboratories at Laramie, Wyo.

The new procedure for determining the approximate oil yield of shale employs a modification of the Fischer cast-aluminum retort, commonly used in low-temperature coal carbonization.

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(B)

PIPE LINES

Industry Group Studies Big-Inch Allocations

WASHINGTON. — A committee of 10 leading gas-company executives were scheduled to meet in Washington this week to assist the Federal Power Commission in working out allocations of natural gas to be made available this winter through emergency use of the big-inch and little big-inch pipe lines.

The industry - advisory committee was designated by FPC last week with the statement that a decision on how and to whom the gas shall be assigned "calls for a thorough knowledge of the operation of the systems involved."

Members of the committee are: Gardner Symonds, president, Tennessee Gas & Transmission Co.; George S. Young, vice president, Columbia Engineering Corp.; C. I. Weaver, president, Ohio Fuel Gas Co.; L. L. Tonkin, president, Hope Natural Gas Co.; J. French Robinson, president, East Ohio Gas Co.; W. G. Maguire, chairman of the board, Panhandle Eastern Pipe Line Co.; D. P. Hartson, vice president, Equitable Gas Co.; J. G. Montgomery, Jr., vice president, United Natural Gas Co.; L. E. Ingham, vice president, Kentucky Natural Gas Co., and L. B. Schiesz, president, Indiana Gas & Water Co.

Last week, FPC staff members and company representatives were canvassing the winter supply situation in the areas served by companies which might be aided by the inch lines. The data were to be available for the deliberations of the commission and its advisory committee.

The commission outlined the general principles which will guide the allocation of the emergency gas supply:

"Gas from the big and little big-inch lines will be allocated, within the limits of available pipe line capacity and interconnections, to assure maintenance of service to presently served customers in as wide an area as possible. First consideraiton will be given to requirements for continuous service to residential and commercial consumers. The remaining supply will be allocated to assure more adequate gas supplies for existing industrial customers."

Prior to a decision on the initial allocation, the commission authorized Tennessee Gas & Transmission Co., which was given an interim lease on the Government-owned lines until April 30, 1947, to deliver the gas to its present customers and gas companies dependent upon these customers. The FPC's instructions directed T. G. & T. to give "due regard to building up pressures which will assure the ultimate maximum use of the lines to meet this winter's emergency." During the interim period, allotment between these customers, FPC said, may be on a pro rata basis "or on such other basis as will best serve to meet future shortages in the region with particular emphasis on deliveries to Ohio Fuel Gas Co. for the purpose of preserving the maximum future deliverability from storage."

Earlier, in Washington, Ralph K. Davies, acting director of the Oil and Gas Division of the Department of Interior, said termination of the coal strike will not affect the Government's contract with T. G. & T. Davies said information from T. G. & T. was that delivery of 50,000,000 cu. ft. daily through the little big-inch line

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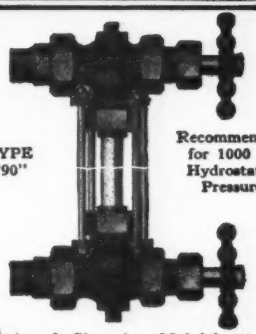

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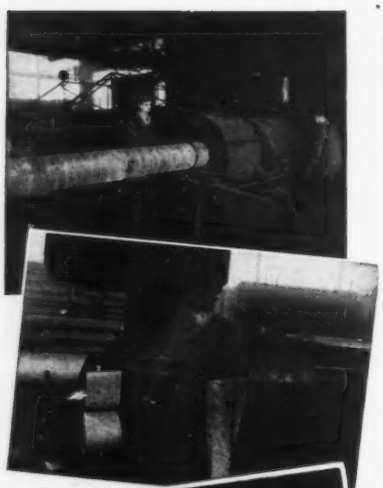

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will be increased to from 100,000,000 cu. ft. to 110,000,000 cu. ft. with the placing in service of the big-inch line, and another 50,000,000 cu. ft. daily will be added as rapidly as necessary connections are completed. (See The Oil and Gas Journal, December 14, page 122, and story below on this page).

T. G. & T. has connected its system with the little big-inch line at Many, La., by means of two 8-in. meter tubes. At Little Rock, Ark., the two inch lines are tied together by a 12-in. connection. At three delivery points in Ohio, the two inch systems are tied together by connections, mostly of 8-in.

Another development in the big-inch situation last week was an unofficial report in Washington that the Department of Interior is asking War Assets Administration to require the transportation of a certain percentage of flare gas as a condition in the final disposal of the properties.

The Oil and Gas Division was said to be preparing specific recommendations along this line for incorporation in the report WAA Administrator Littlejohn is expected to present to Congress. A reversal of the Government's previous stand against selling the lines for gas movement was indicated last month in testimony before the House surplus-property committee.

Inch Lines Transmit Gas to Ohio Customers

Natural gas was being delivered early this week through the big-inch and little-inch lines at the rate of 100,000,000 cu. ft. daily, according to J. P. Bristow, vice president of Tennessee Gas & Transmission Co.

Deliveries of gas to Ohio Fuel Gas Co. and Manufacturers Light, Heat & Power Co. started December 11. To purge the lines of nitrogen approximately 5 days were taken; some of the nitrogen was pushed ahead into the vacant sections of the lines east of the Ohio connections.

In spite of delays caused by breaks at 300 psi. in the feeder lines for the big-inch line in the East Texas area, the transmission program of T. G. & T. for utilizing the "inch" lines has been proceeding ahead of schedule. Pressure is now being raised in the inch lines to raise deliveries to a rate of 150,000,000 cu. ft. daily. Early this week gas was being injected into the inch lines at that rate.

Champlin Asks Rehearing; ICC Withholds Action

WASHINGTON. — The Interstate Commerce Commission has deferred action requiring data on operation of Champlin Refining Co. until the U. S. Supreme Court rules on a petition for a rehearing of its recent decision holding Champlin a common carrier.

Champlin's attorneys are seeking a rehearing and a reversal of the 5 to 4 decision which was confined to Section 19A of the Interstate Commerce Act dealing with valuation of properties. Champlin, engaged in the transportation of oil as a private carrier between Oklahoma and points in Iowa and Kansas, was originally ordered by the commission to furnish all data required of common carriers by the Bureau of Valuation of the ICC. The order was subsequently upheld in federal Circuit Court.

Shell Boosts Throughput To Deer Park, Tex., Plant

Shell Pipe Line Corp. has installed a centrifugal pump unit at Huffman station, Texas, which enables the company to increase throughput by 8,000 bbl. daily between the Goodrich station and the Shell Oil Co., Inc., refinery at Deer Park, Tex.

Lone Star Plans Line

A 35-mile, 6-in. pipe line is being planned by Lone Star Producing Co. from the Eden gas pool in Concho County, Tex., to connect with its 10-in. system to San Angelo at Rowena in Runnels County.

Buckeye Pipeline Trenchers

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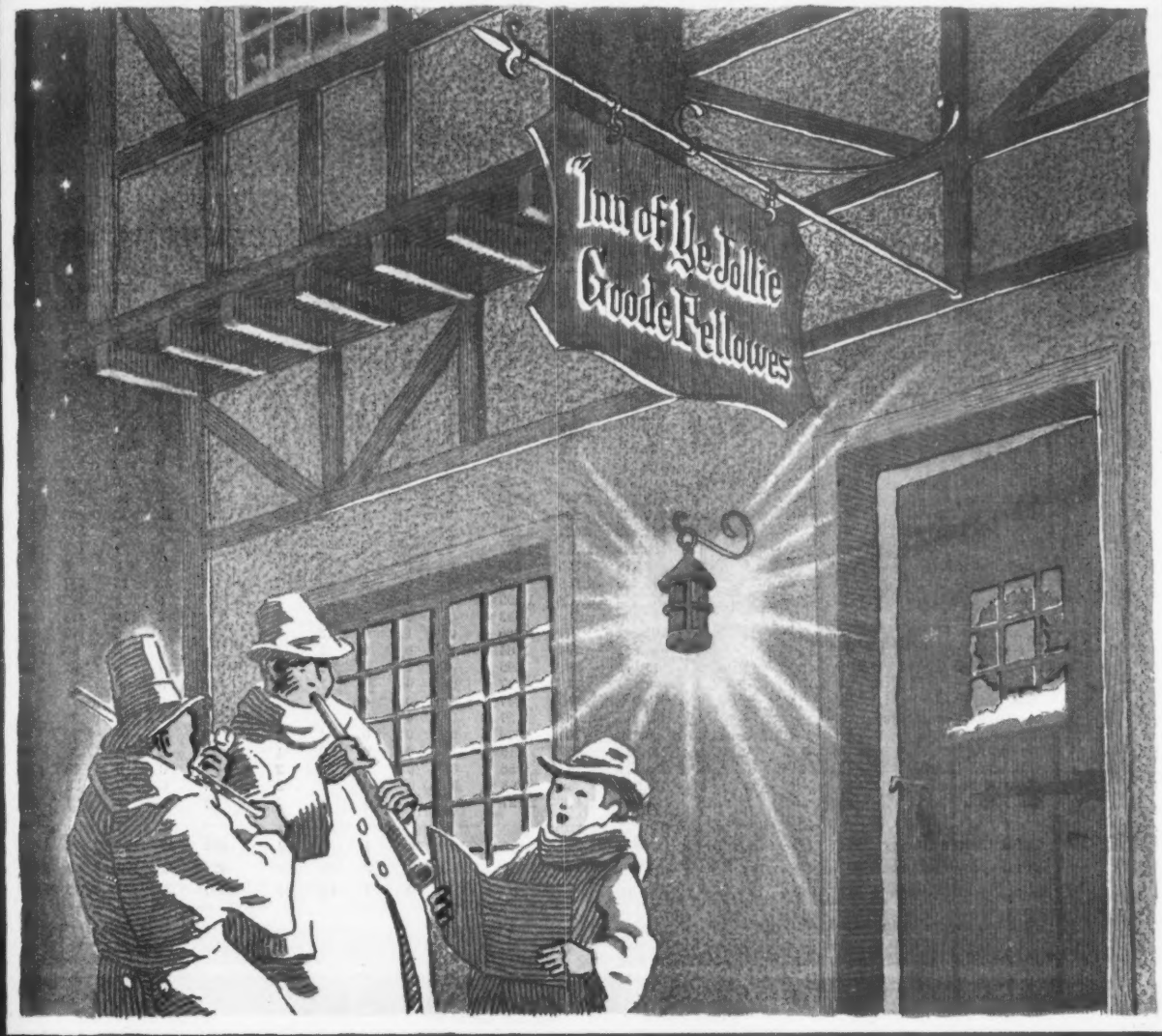

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One of Merriment, Joy and True
Fellowship is Our Heartfelt Wish.
A Very Merry Christmas to All!

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STATISTICS and T

WEEKLY WELL COMPLETIONS . . . WEEK ENDED DECEMBER 14, 1946

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1946				
	Comp.	Oil	Gas	Dry	Footage	1946	1945	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	30	15	0	*15	43,006	1,509	1,416	0	0	0	0	0	0	0	0	0	0
Pennsylvania	76	39	8	†29	121,038	3,791	3,867	0	0	0	0	0	0	0	0	0	0
West Virginia	16	3	13	0	40,829	720	777	0	0	0	0	0	0	0	0	0	0
Ohio	28	7	10	11	74,737	1,221	958	1	0	2	2	5	4	0	16	42	62
Indiana	7	5	0	2	13,319	359	189	1	0	0	0	1	6	0	0	20	26
Kentucky	9	4	2	3	21,286	456	552	0	0	0	0	0	7	0	0	37	44
Illinois	46	19	0	27	128,593	2,199	1,739	1	0	0	12	13	53	0	2	440	495
Michigan	24	7	5	12	44,202	780	734	1	0	0	6	7	22	0	10	246	278
Kansas	42	20	6	‡16	139,095	1,930	1,704	0	0	0	3	3	29	0	2	259	290
Neb., Mo., Iowa	0	0	0	0	0	19	29	0	0	0	0	0	0	0	0	14	14
Oklahoma	68	23	6	39	218,148	2,889	2,312	2	0	0	22	24	93	0	38	402	533
Texas	171	99	12	60	770,830	7,508	6,901	3	1	1	35	40	204	29	33	1,243	1,509
North Central	61	30	1	30	171,472	2,621	2,228	2	0	0	17	19	73	0	4	511	588
West	36	30	0	6	180,340	1,697	1,674	0	0	0	3	3	47	0	1	165	213
Panhandle	12	5	5	2	38,861	300	519	0	0	0	0	0	0	0	0	5	5
Eastern	14	8	3	3	95,905	668	378	0	0	0	2	2	45	22	13	237	317
Gulf Coast	36	24	1	11	246,849	1,656	1,599	1	1	0	7	9	20	5	5	112	142
Southwest	12	2	2	8	37,403	566	503	0	0	1	6	7	19	2	10	213	244
Louisiana	30	18	3	9	191,142	1,344	1,060	0	1	0	3	4	45	14	8	177	244
Northern	14	8	2	4	46,951	763	464	0	0	0	1	1	9	0	3	96	108
Southern	16	10	1	5	144,191	581	596	0	1	0	2	3	36	14	5	81	136
Arkansas	4	1	0	3	24,286	173	177	0	0	0	1	1	8	0	0	38	46
Mississippi	10	3	0	7	72,634	248	347	0	0	0	6	6	1	0	1	72	74
Southeastern States	1	0	0	1	3,210	43	57	0	0	0	1	1	1	0	0	35	36
Montana	6	2	3	1	6,110	304	300	0	0	0	1	1	10	0	4	32	46
Wyoming	4	4	0	0	11,513	162	219	1	0	0	0	1	13	0	3	34	50
Colorado-Utah	3	1	0	2	15,907	163	56	0	0	0	2	2	5	0	0	18	23
New Mexico	13	9	2	2	49,913	388	398	0	0	0	2	2	4	0	0	38	42
California	26	16	1	9	129,502	1,416	2,127	0	0	1	6	7	27	0	7	224	258
Total United States	614	295	71	248	2,119,300	27,622	25,919	10	2	4	102	118	532	43	124	3,371	4,070
Total previous week	525	278	63	184	1,704,013	27,008	25,390	9	1	5	69	74	522	41	120	3,269	3,952
Total Dec. 15, 1945	529	280	54	195	1,754,138			4	0	1	68	73	491	23	131	3,315	3,960

Service wells included: *15, †28, ‡1.

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Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

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19-19.9	1.21			
20-20.9	1.24	$1.30		$1.17
21-21.9	1.28	1.32		1.19
22-22.9	1.32	1.34		1.21
23-23.9	1.35	1.36		1.23
24-24.9	1.39	1.38	$1.61	1.25
25-25.9	1.43	1.40	1.63	1.27
26-26.9	1.46	1.42	1.65	1.29
27-27.9	1.50	1.44	1.67	1.31
28-28.9	1.54	1.46	1.69	1.33
29-29.9	1.57	1.48	1.71	1.35
30-30.9	1.61	1.50	1.73	1.37
31-31.9		1.52	1.75	1.39
32-32.9		1.54	1.77	1.41
33-33.9		1.56	1.79	1.43
34-34.9		1.58	1.81	1.45
35-35.9		1.60	1.83	1.47
36-36.9		1.62	1.85	1.49
37-37.9		1.64	1.87	1.51
38-38.9		1.66	1.89	1.53
39-39.9		1.68	1.91	1.55
40 and above		1.70	1.93	1.57

*For crude from Daboval, El Campo and Sandy Point. †Includes Lea County, New Mexico.

(Quotations shown here are f.o.b plant in tank cars and in cents per gal as of last Monday.

REFINERY GASOLINE

Octane (A.S.T.M.)	78-78½†	73-75
Mid-Continent*	7.375-7.625	6.750-7.000
Tex. Gulf Coast	7.250	6.500-6.750
New York Harbor	9-10.75	8-9.25
California		6.250-6.750

*Basic Oklahoma Group 3. †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades—	26-70	18-55
Oklahoma (Group 3)	5-5.125	6-6.15
N. Texas (f.o.b. plant)	4.375-4.5	5.25-5.4
N. Louisiana (f.o.b. plant)	4.625	5.550
California (averages)	5.500	6.250

CRUDE-OIL PRICES

Representative posted schedules per bbl

East Texas	$1.70
Kettleman Hills, California*	1.69
Beauregard Parish	1.65
Illinois Basin	1.82
Pecos County, Texas (Yates)	1.40
Bradford, Pennsylvania	3.55
Eastern Ill., and Western Ind.	1.67

Note: Crude prices exclusive of subsidy.

A.P.I. REFINERY REPORT

Week ended December 7, 1946

(Figures in thousands of barrels)

	Daily crude runs to stills	Stocks—Gasoline	Stocks—Distillate	Stocks—Residual
East Coast	726	18,930	23,031	10,711
Appalachian	166	3,311	647	609
Ill., Ind., Ky.	760	15,610	7,605	4,816
Okla., Kan., Mo.	377	8,720	3,278	1,317
Inland Texas	210	3,451	575	706
Tex. Gulf Cst.	1,096	13,425	11,093	7,181
La. Gulf Cst.	378	4,730	4,289	2,343
No. La., Ark.	60	1,859	510	161
Rocky Mtn.	136	1,881	507	657
California	811	16,266	12,326	28,618
Total 12- 7-46	4,720	88,183	63,861	57,209
Total 11-30-46	4,707	88,371	66,062	58,647
Total 12- 8-45	4,437	87,694	42,560	44,079

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended—	Bbl. of crude*
December 7, 1946	225,419,000
November 30, 1946	227,693,000
December 8, 1945	218,355,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Dec. 14 crude oil	B. of M. Dec. demand	Dec. 7 crude oil
Alabama	1,150	1 200	1,000
Arkansas	79,950	76,000	79,100
California	876,000	845,000	873,500
Colorado	36,500	32,000	38,520
Eastern	61,500	64,200	64,500
Florida	200	200	215
Illinois	202,200	210,000	201,300
Indiana	19,100	19,000	20,650
Kansas	279,950	263,000	249,550
Kentucky	29,800	29,000	30,300
Louisiana	409,975	382,000	409,085
North Louisiana	99,650	.....	98,900
South Louisiana	310,325	.....	310,185
Michigan	48,605	46,000	44,530
Mississippi	81,850	60,000	80,800
Montana	24,590	24,000	23,480
Nebraska	700	800	750
New Mexico	102,500	98,000	102,215
Oklahoma	370,800	380,000	371,050
Texas	1,996,065	2,050,000	2,010,450
District 1 (Southwest)	18,850	.....	18,870
District 2 (Southwest)	134,775	.....	136,550
District 4 (Southwest)	208,800	.....	211,304
District 3 (Gulf Coast)	422,625	.....	428,582
District 5 (Eastern)	34,615	.....	34,932
District 6 (Eastern)	99,375	.....	100,190
East Texas field	316,000	.....	317,143
District 7C (West)	27,700	.....	27,958
District 8 (West)	499,725	.....	500,800
District 7B (W. Central)	34,000	.....	31,614
District 9 (N. Central)	118.000	.....	118,486
District 10 (Panhandle)	81.100	.....	81,021
Wyoming	103,580	96,000	102,480
Miscellaneous	.....	600	.....
Total United States	*4,725,015	4,677,000	4,703,475

Change from prev. week, up 21,540

Total production January 1-December 14..... †1,654,271,084 bbl.

Same period last year (crude, plus condensate) 1,628,129,525 bbl.

*Not incl. 23,965 bbl. condensate. †Incl. 8,356,760 bbl. condensate.

CRUDE-OIL STOCKS 225,419,000 bbl. as of December 7—down 2,274,000 bbl. One year ago 218,355,000 bbl.

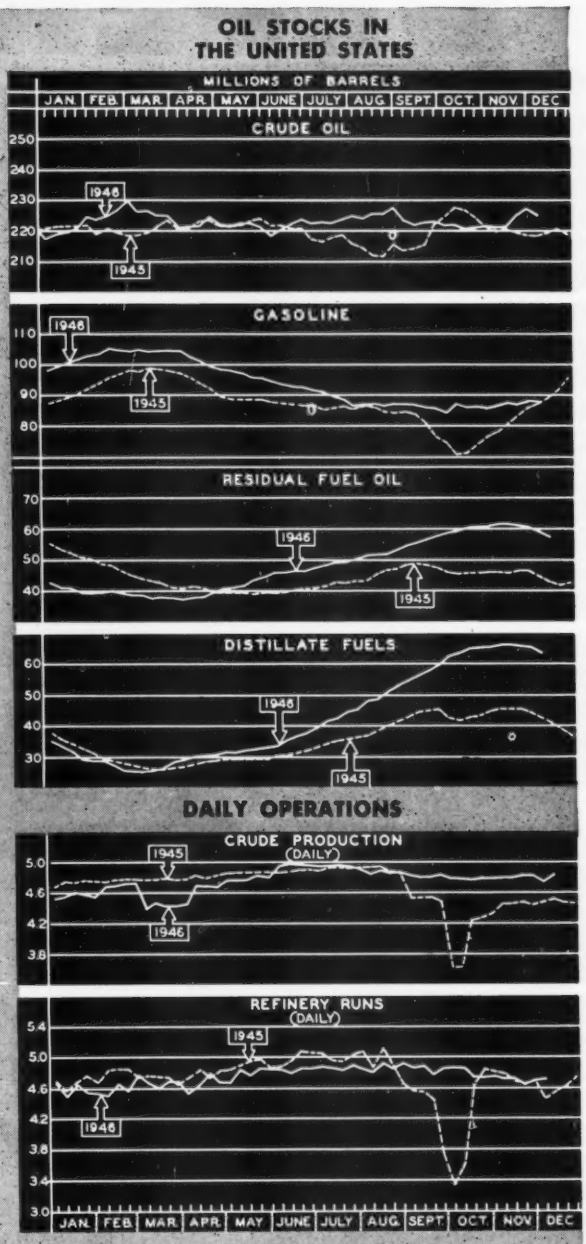
GASOLINE STOCKS 88,183,000 bbl. as of December 7—down 188,000 bbl. One year ago 87,694,000 bbl.

RESIDUAL FUEL-OIL STOCKS 57,209,000 bbl. as of December 7—down 1,438,000 bbl. One year ago 44,079,000 bbl.

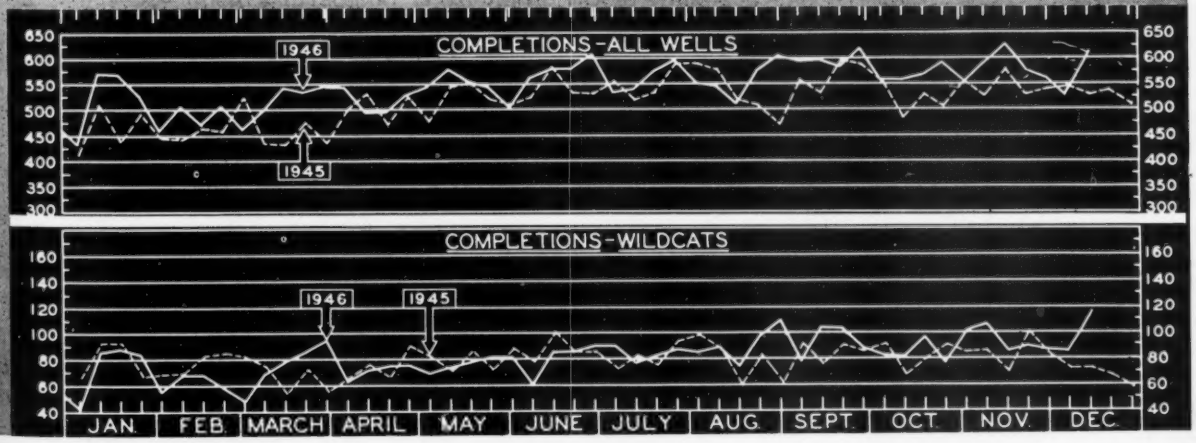
GAS OIL AND DISTILLATE STOCKS 63,861,000 bbl. as of December 7—down 2,201,000 bbl. One year ago 42,560,000 bbl.

CRUDE-OIL PRODUCTION 4,725,015 bbl. as of December 14—up 21,540 bbl. One year ago 4,508,700 bbl.

REFINERY RUNS 4,720,000 bbl. daily week ended December 7—up 13,000 bbl. One year ago 4,437,000 bbl.



Solid line charts weekly completions, service wells in Eastern area included.



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Crude-Oil Prices Effective November 15

SINCE mid-November, higher prices for crude oil have been posted in areas throughout the country except California.

Many of these increases were included in the tabulation published in The Oil and Gas Journal November 30, pp. 54-55. The data are presented again on these two pages because of additional postings received and other changes.

A crude for a particular area or field is found in the listings at the top of the two pages. The numbers with each listing refer to the columns in the table below where prices according to gravity are shown.

The price advance effective November 15 was generally 10 cents per barrel, but various adjustments were made in gravity scales and postings aside from the general pattern. In Pennsylvania, crude oil prices were increased 14 cents a barrel effective December 1, The Oil and Gas Journal, December 14, page 73.

Flat prices were included in the Journal's tabulation November 30, page 57.

For flat prices, see The Oil and Gas Journal, November 30, page 57.

Areas, Fields, Companies Tabulated by State

ARKANSAS

Field, county, parish, pool, posted by—	Price Sched. Col. No.
Ark.-N. La. (sweet) sand—Standard of N. J.	36
Ark.-N. La. Rodessa, etc.—Standard of N. J.	27
Ark.-La.-Tex. (Rodessa)—Magnolia	20
Ark. (sour) lime—Standard of N. J.	38
Schuler (Jones sand)—Phillips	4
Stephens—Ohio Oil	2

COLORADO

Ft. Collins, Wellington—Continental	16
Rangely—Standard (Ind.)	46
Walden—Continental	17

KANSAS

All fields:	
Carter, Continental, Phillips, Standard (Ind.)	5
Pure	9
Sinclair Prairie	27
Skelly	27
White Eagle Oil Pur., Inc.	9

LOUISIANA

Bayou Mallet, etc.—Standard of N. J.	35
Big Lake, Tepetate, etc.—Continental	11
Black Bayou (light), etc.—Shell	11
Black Bayou (heavy), etc.—Shell	28
Caddo—Magnolia	20
Caddo—Stanolind	20
Charenton (below 28°)—Pan American Prod.	39
Cypress Bayou, etc.—Standard N. J.	37
Hackberry E. and W.—Stanolind	22
Jennings—Stanolind	21
La Place, Sorrento, etc.—Pan American Prod.	11
Little Creek, etc.—Standard N. J.	11
Lockport, W. Gueydan, etc.—Magnolia	40
St. Gabriel (F sand)—Shell	13
(For other fields in La. see Ark.-La.)	

MISSISSIPPI

Cranfield, Guinville, etc.—Standard N. J.	35
Eucutta, Heidelburg—Standard N. J.	34

MONTANA-WYOMING

Elk Basin, etc. (Tensleep)—Stanolind	45
Lost Soldier, etc. (Tensleep)—Sinclair Wyoming	23

Prices According to Gravity

A.P.I. gravity—	Wyoming, Montana 1	Arkansas 2	Texas, N. Mexico 3	Arkansas 4	Okla., Tex., Wyo., etc. 5	Texas 6	Texas 7	Texas 8	Okla., Kans., Tex. 9	Texas 10	La., Tex. 11	La., Tex. 12	La., Tex. 13	Texas 14	Texas 15	Colorado 16	Colorado, Texas 17	Texas 18	Texas 19	La., Tex., Ark. 20	Louisiana 21	Louisiana 22	Tex., Wyo., N. Mexico 23
15-15.9	0.95	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-16.9	0.975	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-17.9	1.00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-18.9	1.025	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19-19.9	1.05	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Below 20	...	...	...	...	...	...	...	...	...	1.53	1.38	1.43	1.51	1.48	...	...	...	1.48	...	...	...	...	1.15
20-20.9	1.075	...	...	...	...	...	...	...	...	1.55	1.40	1.45	1.53	1.50	...	...	...	1.50	...	...	...	...	1.17
Below 21	...	...	1.17	1.21	1.30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21-21.9	1.10	...	1.19	1.23	1.32	...	...	...	...	1.57	1.42	1.47	1.55	1.52	...	...	...	1.52	...	...	...	...	1.19
22-22.9	1.125	...	1.21	1.25	1.34	...	...	...	...	1.59	1.44	1.49	1.57	1.54	...	...	...	1.54	...	...	...	...	1.21
23-23.9	1.15	...	1.23	1.27	1.36	...	...	...	...	1.61	1.46	1.51	1.59	1.56	...	...	...	1.56	...	...	...	...	1.23
Below 24	...	...	...	...	...	...	...	1.59	...	...	...	...	...	...	...	...	...	...	1.69	...	...	1.59	...
24-24.9	1.175	...	1.25	1.29	1.38	...	...	1.61	...	1.63	1.48	1.53	1.61	1.58	...	...	...	1.58	1.71	...	...	1.61	1.25
Below 25	...	...	...	...	...	1.40	1.25	...	...	...	...	...	...	...	1.21	...	...	...	...	1.38	...	...	...
25 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25-25.9	1.20	1.38	1.27	1.31	1.40	1.42	1.27	1.63	1.40	1.65	1.50	1.55	1.63	1.60	1.23	...	...	1.60	1.73	1.40	...	1.63	1.27
26-26.9	1.225	1.40	1.29	1.33	1.42	1.44	1.29	1.65	1.42	1.67	1.52	1.57	1.65	1.62	1.25	...	...	1.62	1.75	1.42	...	1.65	1.29
27-27.9	1.25	1.42	1.31	1.35	1.44	1.46	1.31	1.67	1.44	1.69	1.54	1.59	1.67	1.64	1.27	...	...	1.64	1.77	1.44	...	1.67	1.31
28-28.9	1.275	1.44	1.33	1.37	1.46	1.48	1.33	1.69	1.46	1.71	1.56	1.61	1.69	1.66	1.29	...	...	1.66	1.79	1.46	...	1.69	1.33
Below 29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.41	1.46	...	...	...	...	...	...
29 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29-29.9	1.30	1.46	1.35	1.39	1.48	1.50	1.35	1.71	1.48	1.73	1.58	1.63	1.71	1.68	1.31	1.43	1.48	1.68	1.81	1.48	...	1.71	1.35
30 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.83	...	...	...	...
30-30.9	1.325	1.48	1.37	1.41	1.50	1.52	1.37	1.73	1.50	1.75	1.60	1.65	1.73	1.70	1.33	1.45	1.50	1.70	...	1.50	...	1.73	1.37
31-31.9	1.35	1.50	1.39	1.43	1.52	1.54	1.39	1.75	1.52	1.77	1.62	1.67	1.75	1.72	1.35	1.47	1.52	1.72	...	1.52	...	1.75	1.39
Below 32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.57	...	...
32 and above	1.375	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32-32.9	...	1.52	1.41	1.45	1.54	1.56	1.41	1.77	1.54	1.79	1.64	1.69	1.77	1.74	1.37	1.49	1.54	1.74	...	1.54	1.59	1.77	1.41
33-33.9	...	1.54	1.43	1.47	1.56	1.58	1.43	1.79	1.56	1.81	1.66	1.71	1.79	1.76	1.39	1.51	1.56	1.76	...	1.56	1.61	1.79	1.43
Below 34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.81	...
34-34.9	...	1.56	1.45	1.49	1.58	1.60	1.45	1.81	1.58	1.83	1.68	1.73	1.81	1.78	1.41	1.53	1.58	1.78	...	1.58	1.63	...	1.45
35 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	1.80	...	...	...	...	...	...	...	...	...
35-35.9	...	1.58	1.47	1.51	1.60	1.62	1.47	1.83	1.60	1.85	1.70	1.75	1.83	...	1.43	1.55	1.60	1.80	...	1.60	1.65	...	1.47
36 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36-36.9	...	...	1.49	1.53	1.62	1.64	1.49	1.85	1.62	1.87	1.72	1.77	1.85	...	1.45	1.57	1.62	1.82	...	1.62	1.67	...	1.49
37-37.9	...	...	1.51	1.55	1.64	1.66	1.51	1.87	1.64	1.89	1.74	1.79	1.87	...	1.47	1.59	1.64	1.84	...	1.64	1.69	...	1.51
38-38.9	...	...	1.53	1.57	1.66	1.68	1.53	1.89	1.66	1.91	1.76	1.81	1.89	...	1.49	1.61	1.66	1.86	...	1.66	1.71	...	1.53
39-39.9	...	...	1.55	1.59	1.68	1.70	1.55	1.91	1.68	1.93	1.78	1.83	1.91	...	1.51	1.63	1.68	1.88	...	1.68	1.73	...	1.55
40 and above	...	...	1.57	1.61	1.70	1.72	1.57	1.93	1.70	1.95	1.80	1.85	1.93	...	1.53	1.65	1.70	1.90	...	1.70	1.75	...	1.57

Midwestern, Rocky Mountain, Southwestern Areas

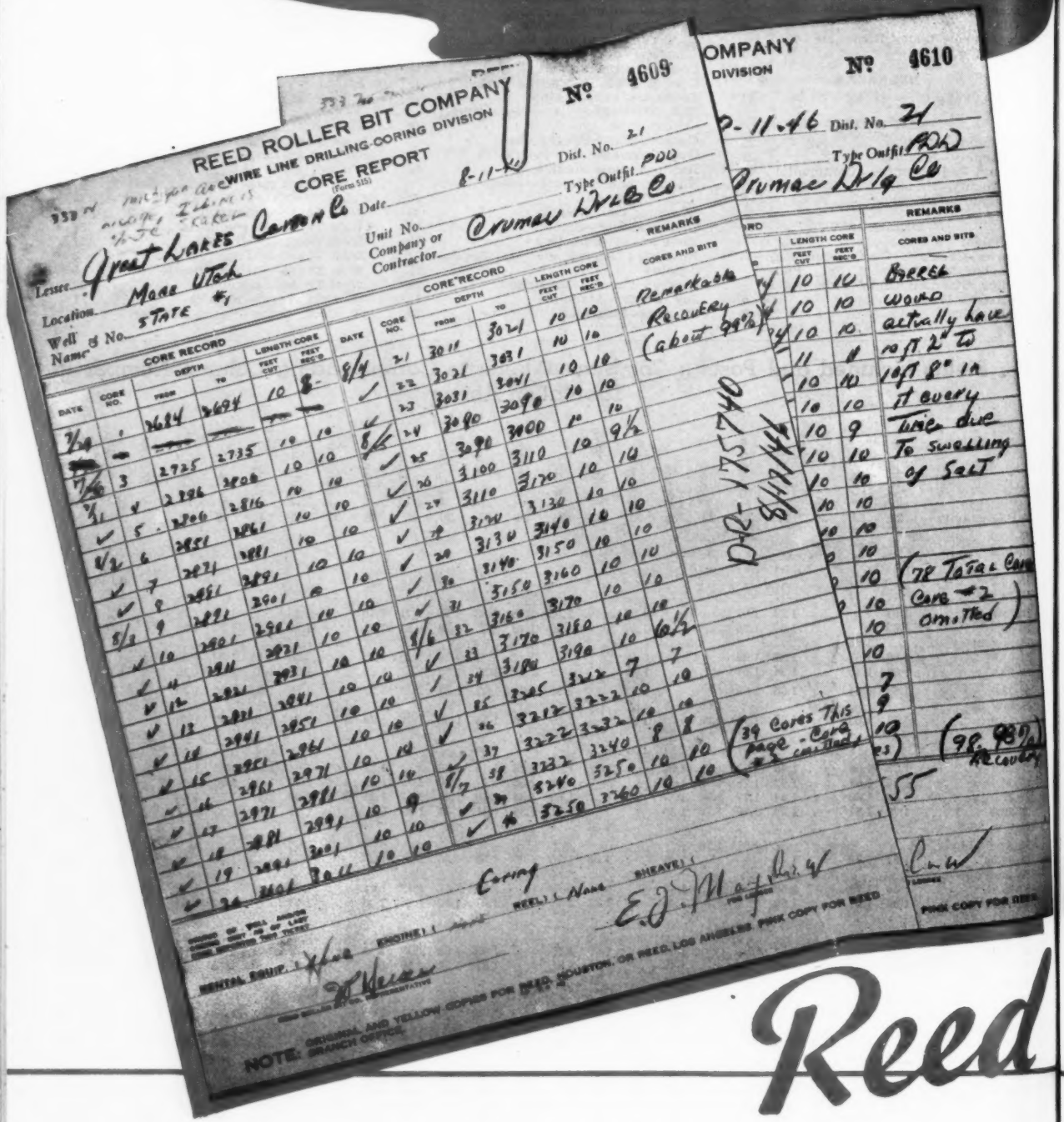
Field, county, parish, pool, posted by—	Price Sched. Col. No.
Elk Basin (Mont.-Wyo.)—Stanolind	5
East Mahoney Dome—Sinclair Wyoming	32
Elk and Oregon Basin (Mont.-Wyo.)—Carter	1
Elk and Oregon Basin (Mont.-Wyo.) Ohio Oil	1
Grass Creek—Standard (Ind.)	5
Hamilton Dome, etc.—Standard (Ind.)	1
Lance Cr. Wyo.—Continental	5
Lance Cr. Wyo.—Carter	5
Lance Creek, etc. and Elk (lt.)—Ohio Oil	5
Lost Soldier, Bailey Dome, etc.—Sinclair Wyoming	5
NEBRASKA	
Barada, Falls City—Skelly	27
NEW MEXICO	
Lea County—Shell	23
Lea County—Magnolia	23
Lea and Eddy counties—Continental	44
Lea County—Humble	23
Lea County—Stanolind	3
OKLAHOMA	
All fields:	
Carter, Champlin, Continental, Magnolia, Mid-Continent Pet., Phillips, Standard (Ind.), Tide Water Assoc., Wilcox	5
Pure Oil*	9
Sinclair Prairie	27
Skelly	27
*Except Keys and North Hobart.	
TEXAS	
Abell—Sinclair Prairie	20
Abell—Magnolia	20
Alfred—Sinclair Prairie	12
Alta Loma—Pan American Prod.	12
Anderson, etc.—Humble	43
Angleton, etc.—Humble	12
Aransas—Atlantic	26
Armstrong, etc.—Humble	18
Barbers Hill—Atlantic Ref. Co.	24
Charlotte, etc.—Humble	41
Comitas, etc.—Humble	29
Coastal Grade A—Sinclair Prairie	19
Dickinson, etc.—Humble	11
Gillock-Dickinson, etc.—Pan American Prod. Co.	11
Goose Creek, etc.—Humble	19
Gulf Coast—Sinclair Prairie	8
Hastings, etc.—Humble	13
Hastings and S. Houston—Pan American Prod. Co.	13
Hawkins, etc.—Humble	31
Hendrick, etc.—Stanolind	23
High Island—Stanolind	13
Howard, Glasscock, etc.—Col-Tex Refining	23
Jackson County—Magnolia	14
Jay Welder—Stanolind	12
Mirando—Magnolia	29
Mirando (Heavy)—Sinclair Prairie	29
Mirando (Light)—Sinclair Prairie	18
Mexia—Sinclair Prairie	6
North Texas—Stanolind	5
North Texas—Continental	17
North Texas—Panhandle Refining	17
N. and N. Central Texas—Magnolia	17
North Central Texas—Sinclair Prairie	27
Panhandle—Magnolia	17
Panhandle—Phillips	5
Pearsall—Humble	42
Refugio and Greta—Atlantic	25
Refugio, etc.—Humble	10
Saxet—Sinclair Prairie	33
Seeligson—Magnolia	12
Spindle Top, etc.—Stanolind	19
Starr County—Continental	18
Talco—Magnolia	31
Wade City, etc.—Sinclair Prairie	10
West Texas (with exceptions)—Atlantic, Shell, Magnolia	23
West Texas (with exceptions)—Stanolind	3
West Texas (with exceptions)—Humble	23
West Texas—Atlantic	27
West Texas—Magnolia	30
West Texas—Shell	27
West Texas—Phillips	3
West Texas—Sinclair Prairie	7
West Texas—Stanolind	30
W. Cent. Texas—Humble	27
W. Cent. Texas—Panhandle Ref.	9

For Fields Included and Posting Companies, Refer to Corresponding Column Number in Tabulation Above

A.P.I. gravity—	24 Texas	25 Texas	26 Ark., Tex.	27 Ark., La., etc.	28 Louisiana	29 Texas	30 Texas	31 Texas	32 Mont., Wyo.	33 Texas	34 Mississippi	35 La., Miss.	36 Ark., La.	37 Louisiana	38 Arkansas	39 Louisiana	40 Louisiana	41 Texas	42 Texas	43 Texas	44 N. Mexico	45 Mont., Wyo.	46 Colorado
15-15.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16-16.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17-17.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18-18.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.025	...
19-19.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.05	...
Below 20	1.61	...	...	1.28	1.61	...	...	1.25	...	1.53	1.16	1.33	1.26	1.21	1.19	...	1.48	1.25	1.20	1.30	...	...	...
20-20.9	1.63	...	...	1.30	1.63	...	...	1.27	...	1.55	1.18	1.35	1.28	1.23	1.21	...	1.50	1.27	1.22	1.32	...	1.075	...
Below 21	...	1.55	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.20
21-21.9	1.65	1.57	...	1.32	1.65	...	...	1.29	...	1.57	1.20	1.37	1.30	1.25	1.23	...	1.52	1.29	1.24	1.34	...	1.10	1.22
22-22.9	1.67	1.59	...	1.34	1.67	...	...	1.31	...	1.59	1.22	1.39	1.32	1.27	1.25	...	1.55	1.31	1.26	1.36	...	1.125	1.24
23-23.9	1.69	1.61	...	1.36	1.69	...	...	1.33	...	1.61	1.24	1.41	1.34	1.29	1.27	...	1.58	1.33	1.28	1.38	...	1.15	1.26
Below 24	...	...	...	...	...	1.66	...	...	...	...	...	...	...	...	...	1.69	...	...	...	...	...	...	...
24-24.9	1.71	1.63	...	1.38	1.71	1.68	...	1.35	...	1.63	1.26	1.43	1.36	1.31	1.29	1.71	1.61	1.35	1.30	1.40	...	1.175	1.28
Below 25	...	...	...	...	...	...	1.31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25 and above	...	...	...	...	...	...	...	1.37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25-25.9	1.73	1.65	...	1.40	1.73	1.70	1.33	...	...	1.65	1.28	1.45	1.38	1.33	1.31	1.73	1.64	1.37	1.32	1.42	...	1.20	1.30
26-26.9	1.75	1.67	...	1.42	1.75	1.72	1.35	...	...	1.67	1.30	1.47	1.40	1.35	1.33	1.75	1.67	1.39	1.34	1.44	...	1.225	1.32
27-27.9	1.77	1.69	...	1.44	1.77	1.74	1.37	...	...	1.69	1.32	1.49	1.42	1.37	1.35	1.77	1.69	1.41	1.36	1.46	...	1.25	1.34
28-28.9	1.79	1.71	...	1.46	1.79	1.76	1.39	...	...	1.71	1.34	1.51	1.44	1.39	1.37	...	1.71	1.43	1.38	1.48	...	1.275	1.36
Below 29	...	...	...	...	...	...	...	...	1.31	...	...	...	...	...	...	...	...	...	...	...	1.33	...	...
29 and above	...	...	...	...	1.81	1.78	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29-29.9	1.81	1.73	...	1.48	...	...	1.41	...	1.33	1.73	1.36	1.53	1.46	1.41	1.39	...	1.73	1.45	1.40	1.50	1.35	1.30	1.38
30 and above	...	...	...	...	...	...	...	...	...	...	1.38	...	...	...	...	...	...	...	...	...	...	...	...
30-30.9	1.83	1.75	...	1.50	...	...	1.43	...	1.35	1.75	...	1.55	1.48	1.43	1.41	...	1.75	1.47	1.42	1.52	1.37	1.325	1.40
31-31.9	1.85	1.77	...	1.52	...	...	1.45	...	1.37	1.77	...	1.57	1.50	1.45	1.43	...	1.77	1.49	1.44	1.54	1.39	1.35	1.42
Below 32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.375	...
32-32.9	1.87	1.79	...	1.54	...	...	1.47	...	1.39	1.79	...	1.59	1.52	1.47	1.45	...	1.79	1.51	1.46	1.56	1.41	...	1.44
33-33.9	1.89	1.81	...	1.56	...	...	1.49	...	1.41	1.81	...	1.61	1.54	1.49	1.47	...	1.81	1.53	1.48	1.58	1.43	...	1.46
Below 34	...	...	1.68	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34 and above	1.91	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.83	...	...	...	...	...	...
34-34.9	...	1.83	1.70	1.58	...	...	1.51	...	1.43	1.83	...	1.63	1.56	1.51	1.49	...	...	1.55	1.50	1.60	1.45	...	1.48
35 and above	...	...	...	...	...	...	...	...	...	1.85	...	...	...	...	...	...	...	...	...	...	...	...	...
35-35.9	...	1.85	1.72	1.60	...	...	1.53	...	1.45	...	...	1.65	1.58	1.53	1.51	...	...	1.57	1.52	1.62	1.47	...	1.50
36 and above	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36-36.9	...	1.87	1.74	1.62	...	...	1.55	...	1.47	...	...	1.67	1.60	1.55	1.53	...	...	1.59	1.54	1.64	1.49	...	1.52
37-37.9	...	1.89	1.76	1.64	...	...	1.57	...	1.49	...	...	1.69	1.62	1.57	1.55	...	...	1.61	1.56	1.66	1.51	...	1.54
38-38.9	...	1.91	1.78	1.66	...	...	1.59	...	1.51	...	...	1.71	1.64	1.59	1.57	...	...	1.63	1.58	1.68	1.53	...	1.56
39-39.9	...	1.93	1.80	1.68	...	...	1.61	...	1.53	...	...	1.73	1.66	1.61	1.59	...	...	1.65	1.60	1.70	1.55	...	1.58
40 and above	...	1.95	1.82	1.70	...	...	1.63	...	1.55	...	...	1.75	1.68	1.63	1.61	...	...	1.67	1.62	1.72	1.57	...	1.60

We show you this Core Report to further prove what our salesmen have been telling you about REED "BR" Wire Line . . .

Recovery with 78 Cores 98.98%



REED ROLLER BIT COMPANY
WIRE LINE DRILLING-CORING DIVISION
CORE REPORT (Form 515)

No. 4609

Lessee Great Lakes Carbon Co
Location Mona Utah
Well & No. State #1
Date 8-11-46
Dist. No. 21
Type Outfit RDD
Unit No.
Company or Contractor Drumac Drlg Co

CORE RECORD

DATE	CORE NO.	DEPTH FROM	DEPTH TO	LENGTH CORE FEET CUT	LENGTH CORE FEET REC'D
8/4	1	3684	3694	10	8
	2				
	3	2725	2735	10	10
7/30	4	2796	2806	10	10
8/1	5	2806	2816	10	10
✓	6	2851	2861	10	10
8/2	7	2871	2881	10	10
✓	8	2881	2891	10	10
✓	9	2891	2901	10	10
8/3	10	2901	2911	10	10
✓	11	2911	2921	10	10
✓	12	2921	2931	10	10
✓	13	2931	2941	10	10
✓	14	2941	2951	10	10
✓	15	2951	2961	10	10
✓	16	2961	2971	10	10
✓	17	2971	2981	10	9
✓	18	2981	2991	10	10
✓	19	2991	3001	10	10
✓	20	3001	3011	10	10
8/4	21	3011	3021	10	10
✓	22	3021	3031	10	10
✓	23	3031	3041	10	10
8/5	24	3080	3090	10	10
✓	25	3090	3100	10	9½
✓	26	3100	3110	10	10
✓	27	3110	3120	10	10
✓	28	3120	3130	10	10
✓	29	3130	3140	10	10
✓	30	3140	3150	10	10
✓	31	3150	3160	10	10
8/6	32	3160	3170	10	10
✓	33	3170	3180	10	6½
/	34	3180	3190	7	7
✓	35	3205	3212	7	10
✓	36	3212	3222	10	10
✓	37	3222	3232	10	10
8/7	38	3232	3240	8	8
✓	39	3240	3250	10	10
✓	40	3250	3260	10	10

(39 Cores This Page - Core #2 omitted)

REMARKS — CORES AND BITS
Remarks
Recovery (about 99%)

Coring
RENTAL EQUIP.
ENGINE(S)
REEL(S) Name SHEAVE(S)
E. J. Mayhew
NOTE: ORIGINAL AND YELLOW COPIES FOR REED HOUSTON, OR REED LOS ANGELES. PINK COPY FOR REED BRANCH OFFICE.

COMPANY
DIVISION
No. 4610
8-11-46 Dist. No. 21
Type Outfit RDD
Drumac Drlg Co

DATE	CORE NO.	DEPTH FROM	DEPTH TO	LENGTH CORE FEET CUT	LENGTH CORE FEET REC'D
8/7	41	3260	3270	10	10
✓	42	3270	3280	10	10
✓	43	3280	3290	10	10
✓	44	3290	3300	10	9
✓	45	3300	3310	10	10
✓	46	3310	3320	10	10
✓	47	3320	3330	10	10
✓	48	3330	3340	10	10
✓	49	3340	3350	10	10
✓	50	3350	3360	10	10
✓	51	3360	3370	10	10
✓	52	3370	3380	10	10
✓	53	3380	3390	10	10
✓	54	3390	3400	10	10
✓	55	3400	3410	10	10
✓	56	3410	3420	10	10
✓	57	3420	3430	10	10
✓	58	3430	3440	10	10
✓	59	3440	3450	10	10
✓	60	3450	3460	10	10
✓	61	3460	3470	10	10
✓	62	3470	3480	10	10
✓	63	3480	3490	10	10
✓	64	3490	3500	10	10
✓	65	3500	3510	10	10
✓	66	3510	3520	10	10
✓	67	3520	3530	10	10
✓	68	3530	3540	10	10
✓	69	3540	3550	10	10
✓	70	3550	3560	10	10
✓	71	3560	3570	10	10
✓	72	3570	3580	10	10
✓	73	3580	3590	10	10
✓	74	3590	3600	10	10
✓	75	3600	3610	10	10
✓	76	3610	3620	10	10
✓	77	3620	3630	10	10
✓	78	3630	3640	10	10

REMARKS — CORES AND BITS
Bores would actually have 10 ft 2" to 10 ft 8" in it every time due to swelling of salt

(78 Total Cores Core #2 Omitted)

(98.98% Recovery)

55

PINK COPY FOR REED

Reed

The REED "BR" *Wire Line* CORING-DRILLING OUTFIT

does give you better Wire Line Coring Results

The Crumac Drilling Company, testing a salt deposit for the Great Lakes Carbon Company at Moab, Utah, took 78 cores from 2684" to 3645" with a recovery of 98.98%.

Many factors enter into the results that are achieved with the Reed "BR". The ability of the crew, is, of course, essential, but incorporated in the design of the Reed "BR" are features not to be found in any other Wire Line Core Drill. Among these are:

The Protrusion Regulator Spring, which regulates Protrusion of the Core Cutter Head through the drilling bit.

Replaceable Core Barrel cutter heads for constant coring efficiency.

New forged steel hard formation cutter heads for greater footage and safety—and many others.

On your next Wire Line Coring job, specify the Reed "BR" for better core recovery.

THE EFFICIENT CRUMAC DRILLING CREW

LEFT TO RIGHT IN PICTURE — **Bill Stanbach, Reed Roller Bit Co.; Paul Heiser, Reed Roller Bit Co.; N. L. Steele, derrick man; W. L. Bean, driller; E. Z. Clark, pipe racker; H. C. Waters, driller; George Skakel, Jr., back up man; E. J. Mayhew, geologist; Rushton Skakel, pipe racker; C. A. Loueridge, pipe racker; E. L. Andrews, driller; Roy Ashford, back up man; C. A. Tisdale, derrick man; B. J. Andrews, back up man.**

ROLLER BIT COMPANY

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(Avda. Roque Saenz Pena 501)
Buenos Aires, Argentina

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New York 20,
New York

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59 Wool Exchange
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England

Illustration shows typical application being made to salt water disposal tubing by Green Contracting and Engineering Company, Inc., Wichita, Kansas.

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Ravages of corrosion send millions of dollars worth of pipe and other costly equipment to the junk pile before its time. AMERCOAT produces a long-lasting, non-brittle coating that gives positive corrosion protection. In addition, there is negligible reduction of inside diameters and much lower friction loss.

Since AMERCOAT is unaffected by salt water, crude, acids, alkalies and sulfur compounds, it is being successfully used for the protection of:

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Cost is negligible, compared to failure of vital equipment, loss of materials, wasted time and expensive repairs. Application can be made quickly. For full details, write us about your needs today.

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it almost runs itself!

NEW EXTRUDED COATING improves application and welding characteristics of **STOODY SELF-HARDENING***

*For HARDFACING all wearing equipment where Impact and Abrasion are involved.

FROM ALL OVER THE NATION come enthusiastic reports on ease and speed of applying the new Extrusion COATED STOODY SELF-HARDENING! This harder, more uniform coating brings improved welding performance: Slashes welding time, assures dense deposits, minimizes porosity!

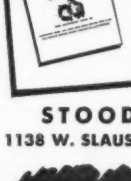
NO MORE TEDIOUS SCALING—where multiple passes are required, slag is easily removed while deposits are still hot—*is SELF-LIFTING as deposits cool!*

AC-DC APPLICATION—use either type machine. Amperage adjustment isn't fussy . . . good arc characteristics over a wide range! Can be deposited in any bead type or welded in any position.

NO CHANGE IN PHYSICAL CHARACTERISTICS—you get the same high wear resistance, same hardness—even on multiple passes!

GIVE THE NEW COATED STOODY SELF-HARDENING A WHIRL. You'll *like* the way it handles, you'll grin with satisfaction at results . . . for it's the same wear resistant metal that's won and held its place on merit for 20 years . . . now improved for easier, faster welding.

600 Distributors can supply you. Choice of 1/8", 5/32", 3/16" and 1/4" diameters. No change in price!



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NATURAL GAS

Rate Hearing Resumption Postponed to January 7

WASHINGTON. — Resumption of the hearing on rates of Pittsburgh & West Virginia Gas Co. and Kentucky West Virginia Gas Co. has been postponed from December 17 to January 7, the Federal Power Commission announced last week. The hearing was recessed December 4 and will reconvene in the commission's hearing room, in Washington.

Postponement was made at the request of counsel for the two companies. The proceedings concern an investigation of the two companies' rates subject to FPC jurisdiction and are the result of a complaint filed by the City of Pittsburgh in March 1945. The complaint alleged that the wholesale rates charged by the Kentucky company for the sale of natural gas to the Pittsburgh company and by the Pittsburgh company to Equitable Gas Co., which distributes gas at retail in Pittsburgh and vicinity, are unjust and unreasonable.

Gas Firms Request Delay in Conversion

PITTSBURGH. — Shortage of pipe and a 50 per cent increase in the use of natural gas last week prompted three Pittsburgh companies to ask consumers to delay conversion of their heating systems from coal to gas until next year, at least.

Spokesmen for the companies, Equitable Gas Co., Manufacturers Light & Heat Co., and Peoples' Natural Gas Co., emphasized that there is sufficient gas available but that pipe lines already approved for construction are being delayed by a shortage of materials.

Memphis Natural's Rate Proposal Suspended

WASHINGTON.—The Federal Power Commission last week suspended rate schedules filed by Memphis (Tenn.) Gas Co. which would have increased rates for gas delivered to Arkansas Power & Light Co., Mississippi Power & Light Co., West Tennessee Gas Co., and the City of Memphis, by $240,000 annually.

The basic change proposed in the rates was an increase of 1.1 cents per 1,000 cu. ft. in the price of gas delivered under the general-service classification. The present rate for this classification averages approximately 15.6 cents. Protests against the proposed rate increase have been made by several companies.

The commission's order suspending the increased rates stated that the rates, charges and classifications set forth in the supplements may be "unjust and unlawful" and may place an "undue burden upon the ultimate consumers of natural gas." Date upon which the matters involved are to be heard will be set by further order, the commission said.

A.G.A. Names Promotion Aide

NEW YORK. — Appointment of Clifford E. Hall as assistant director of the Promotional Bureau of the American Gas Association has been announced by H. Carl Wolf, A.G.A. managing director. Before joining the A.G.A. Promotional Bureau last July, Hall was assistant director of public relations for American Home Products Corp.

Texas Gas Investigating Committee Ends Hearings

DALLAS. — The Senate gas-resources investigating committee's last of a series of hearings to determine the possible need for new laws dealing with natural-gas resources, was held December 14 at Carthage, Tex.

Legislation proposed would give landowners one-eighth royalty in a natural-gas field, and witnesses representing both royalty owners and producing companies approved a suggested standard leasing form to protect the interest of the royalty owners. Use of the form, however, would be prohibited in those fields which could not meet the one-eighth royalty requirements.

Inhibitors Developed

AUSTIN. — Two chemical aids in combating gas-condensate well corrosion have been developed by University of Texas researchers. The chemicals, according to Dr. Norman Hackerman, associate professor of chemistry, are naphthenic acid and sodium chromate or dichromate. Developments in the program, financed by the Natural Gasoline Association of America, are tested on wells under actual operating conditions.

Rate Schedule Suspended

WASHINGTON.—A proposed rate schedule filed by Panhandle Eastern Pipe Line Co. which would eliminate Panhandle's obligation as to volume of gas deliveries to Central Indiana Gas Co., has been suspended by the Federal Power Commission pending a hearing.

Michigan Company Bought

Michigan Consolidated Gas Co. has completed purchase at $1,500,000 of West Michigan Consumers Co., Muskegon, acquiring natural-gas reserves and plant equipment in Muskegon, Osceola, Mecosta, and Isabella counties. The West Michigan company was organized in 1928 by Muskegon industrialists.

California Studies Ban on Industrial Gas Use

LOS ANGELES.—Elimination of natural gas as an industrial fuel in the Los Angeles Basin territory was advocated here last week before the California Public Utilities Commission. Conversion of industrial-fuel requirements to residual oils as replacement for natural gas was advocated as a conservation measure.

If the present rate of domestic and industrial consumption of natural gas in the Los Angeles Basin territory continues, indigenous supplies will be exhausted by 1955. Statistical support for this conclusion was presented at the hearing here by Homer Ross, senior utilities engineer for the commission and by Roy A. Wehe, assistant director of the public-utilities department. They estimated total gas reserves for California at the start of 1946 at 11,421,450,939,000 cu. ft. with only 1,000,000,000,000 of the total in the Los Angeles Basin.

Population growth and increased industrial demand raised consumption figures to approximately 5 per cent of the total for the state and 11 per cent for the Los Angeles area during 1945.

The pipe line from Texas being built by Southern California Gas Co. and the Southern Counties Gas Co. is expected to add 305,000,000 cu. ft. daily to the Los Angeles area supply after the winter of 1947-48.

The Public Utilities Commission advocates husbanding of meager and dwindling natural-gas supplies in the Los Angeles area, particularly, for domestic consumption. Other hearings, possibly culminating in legislation to force industry to use residual fuel oil, will be held in January or February.

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Exploration and Drilling

Barber Co., Kansas, Simpson Play

THE long-anticipated Simpson sand play in Barber County, Kansas, appeared ready to swing into full speed as two wells in the past week attracted wide interest among operators in this area. Continental Oil Co. and Kennecott Copper Co. 1 Smith, NW NW NW 21-33s-12w, a wildcat some 3 miles east of the Medicine Lodge gas field, appears good for 50 to 100 bbl. per hour from the Simpson, gravity ranging in reports from 24.5° to 27°. Meantime Sinclair-Prairie Oil Co. 3 Oldfather, NW SW SE 7-31s-14w, that company's third Simpson test in the Skinner Ranch area, flowed 343 bbl. of 36° oil in 5 hours. The Continental well is not far from Skelly Oil Co. 1 Boggs "C," SW NE NE 17-33s-12w, a small Simpson well, which opened last August what has been named the Boggs pool.

The following top data cover the three wells mentioned. Continental 1 Smith, elevation 1,532 ft., Lansing —2,340 ft., Mississippi lime —3,040 ft., Misener —3,203 ft., Viola —3,206 ft., Simpson sand —3,317 ft. Skelly 1 Boggs "C," elevation 1,515 ft., Lansing —2,345 ft., Mississippi lime —2,897 ft., Viola —3,184 ft., Simpson shale —3,291 ft., Simpson sand —3,296 ft. Sinclair-Prairie 3 Oldfather, elevation 1,645 ft., Lansing —2,108 ft., Viola —2,676 ft., Simpson sand —2,794 ft.

Intervals between the top of the Viola and the top of the Simpson sand are 111 ft., in the Continental test, 112 ft., in the Skelly well, 118 ft. in the Sinclair-Prairie 3 Oldfather, and 127 ft. in its 2 Oldfather, which was something of a disappointment.

This area has been closely watched for a long time by many geologists, and interest began stepping up last March, when Sinclair-Prairie 1 Oldfather, CSE 7-31s-14w, was plugged back from the Arbuckle and began flowing oil from the Simpson. (See The Oil and Gas Journal March 23, 1946, page 131).

For a long time these geologists have felt that there would eventually develop a string of oil pools along a line of folding south and west of the Central Kansas Uplift, roughly parallel to it. At about the point where the folding might well develop, the Simpson, coming up out of the Andarko basin to the south, is nearing the wedge-out point.

Granted a certain combination of geological conditions, it seemed logical to expect good Simpson production. This combination called for the proper sand development in the Simpson, not too near the wedge-out point, but reasonably close to it. There must be substantial Mississippian cover, but not the 1,000 ft. thickness that prevails farther south, since this would throw the Simpson too low to produce. Some thinning in the Viola would be desirable.

If subsequent development should find prolific Simpson production in the Barber County area, there will be even more interest in determining the accurate projection of the probable northwest structural trend, where the combination of geological conditions in Simpson time was right, paralleling the Central Kansas Uplift all the way or nearly so.

Particular attention will be paid to spots that appear to be in the northwest trend of potential Simpson, and at the same time so located as to intersect the southwest trend of productive pools that run roughly at right angles to the Central Kansas Uplift. These are obvious on any pool map of Kansas. The geologists figure that where the two trends intersect, that is, where the folds cross, larger pools should develop.

For the moment the low gravity, 24.5° to 27° reported in the Continental discovery is a minor mystery. Low-gravity oil and Simpson are simply not natural combinations, according to almost all experience in Oklahoma and Kansas to date. Even the 36° oil in the Sinclair-Prairie Oldfather wells is a bit on the low side for normal Simpson, and the 39° gravity oil in the Skelly Boggs pool opener is about what would be expected.

APPALACHIAN FIELD

New Test Staked Northwest Of Large Gas Discovery

PITTSBURGH. — On Briery anticline in Portland district, Preston County, West Virginia, Wm. E. Snee, Orville Eberly et al have rig standing for a test on Cora E. Lewis farm 940 ft. northwest of the 4,000,000-cu. ft. wildcat on Harrison Sisler which these operators completed the last of September. The new gas line to the new pool is completed but waiting on regulators. No test has been made of the well in the line.

In Williamsburg district, Greenbrier County, Texas Co. is drilling at 5,565 ft. in the rotary wildcat on G. R. Dean tract, with the top of the Marcellus at 5,104 ft. The Oriskany sand should soon be tested.

New locations total 27 and were located in Barbour, Boone, Braxton, Cabell, Clay, Doddridge, Jackson, Kanawha, Logan, Marion, Ritchie, and Upshur counties.

In the Young pool in North Strabane Township, Washington County, Charles E. Young completed 1 Mary Neill which is currently producing 50 bbl. a day. Gordon sand was found at 2,511-49 ft., oil and gas at 2,541-44 ft., and total depth was 2,560 ft.

On Chestnut Ridge in Georges Township, Fayette County, four wells are drilling to the lower Devonian, and three are offsets to the large gas well on the Smith farm. Completed late in September, this well is still feeding over 11,000,000 cu. ft. gas a day in the line from the Onondaga chert beds and holding a back pressure on the well.

Only one new location was made during the week which was in South Bend Township, Armstrong County.

EASTERN TEXAS

Completion Tests Under Way at Smith County Discovery

DALLAS. — Delta Drilling Co.'s Paluxy discovery, the 1 W. H. Boynton, 1 mile east of Mount Sylvan, in northwest Smith County, had total depth at 7,727 ft., set casing through the pay section and was preparing to make completion tests. Perforations were made at 7,512-28 ft., 2-in. tubing run to 7,503 ft., the hole washed with water and swabbed down to 3,700 ft. from the top. The well started flowing through ½-in. choke and is now cleaning itself into pits. An estimate on the flow of oil had not been made at the last report. An earlier drill-stem test at 7,516-29 ft. produced a good blow of air and recovered 1,470 ft. of water cushion, plus 4,000 ft. of free oil. Further cores below 7,516-27 ft. gave no indications of additional pay and a test at 1,655-66 ft. showed no oil or gas. Electric log tops, on an elevation of 528 ft., were: Pecan 3,280 ft., Austin chalk 4,600-4,835 ft., Woodbine 5,165 ft., Comanchian 6,116 ft., Main Street 6,262 ft., Fort Worth 6,844 ft., Duck Creek 7,114 ft., Kiamichi shale 7,282 ft., Paluxy 7,469

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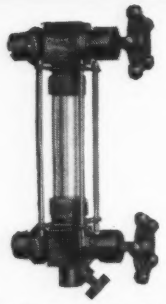

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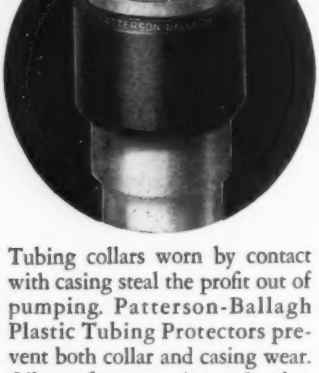

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ft., and Paluxy sand at 7,516-27 ft. The well is on a Magnolia Petroleum Co. farmout and is supported by several majors, but leasing activity is said to be held back by the unfavorable history of the Mount Sylvan pool opener.

Leon County wildcats showing for possible field openers are Danel Oil Co. 1 Cox, 4 miles southeast of Flynn, which had total depth at 7,447 ft. and was pulling tubing to wash with oil in an effort to clean the hole of mud. The well was sawbbed in, then flowed an estimated 150 bbl. of oil daily through ½-in. tubing choke; began making heads of oil, then died. Production was from perforations at 7,036-7,428 ft. in the Woodbine.

United North & South Development Co. 1 Oden et al, 2 miles south of Flynn, flowed some 30 bbl. of fluid daily, running a little over half oil. Operators killed the flow in an effort to shut off water. Previous perforations at 6,887-7,337 ft. flowed from 25 to 100 bbl. of oil a day through 16/64-in. on tubing.

EAST TEXAS WILDCAT FAILURES

Houston County: John S. Ivy et al 3 G. L. Murray & Sons, John Durst Sur., 4 mi. SW of Creek, elev. 189 ft., dry, TD 9,551 ft., electric log tops: Wilcox 1,361 ft., sub-Clarksville 7,793 ft., Woodbine sand 7,883 ft., lower Woodbine sand 8,472-8,504 ft.

Van Zandt County: F. H. Jarrell et al 1 Clara McLaughlin, Smith Robinson Sur., 4 mi. E of Mabank, elev. 441 ft., dry, TD 4,500 ft., sample tops: Navarro 1,030 ft., Pecan 2,270-2,490 ft., Austin 3,150-3,660 ft., Woodbine 4,140 ft., with salt water.

SOUTHWEST TEXAS

New Oil Pool Opened In Live Oak County

CORPUS CHRISTI.—A new oil pool in southeastern Live Oak County, 2 miles northeast of the old Lucas gas field, has been opened by Henshaw Brothers and E. H. Smith 1 H. N. Schwartz et al. On potential gage it flowed 46 bbl. of 23.5°-gravity oil per day through a ⅛-in. choke. Gas-oil ratio 841:1, tubing pressure 125 lb., casing, 675 lb. Total depth is 4,495 ft., with top of pay at 4,011 ft. Production is through perforations at 4,016-19 ft. The 5½-in. casing is set at 4,097 ft. This new discovery is located in John McMullen Survey and has been named "Schwartz."

Also in Live Oak County, 6 miles southeast of George West,' Smith-Story-Wood Corp. 1 E. W. McWhorter, wildcat well, flowed 10 bbl. of 41°-gravity oil and 10 bbl. of salt water per day through a ⅛-in. choke. Production is through perforations at 4,112-14 ft. The casing was set at 4,122 ft. on bottom, and first test made in perforations at 4,112-16 ft. in Pettus sand, where oil and salt water was swabbed; then operators drilled to a depth of 4,200 ft. and ran electric log before plugging back to reperforate for the second test.

Daubert and Achning 1 M. Villareal, new oil-discovery well in northeast Starr County, 1¼ miles southeast of the Kelsey (shallow) field, has run potential gage of 152 bbl. of oil per day through a ⅛-in. choke, with gas-oil ratio of 385:1. Tubing pressure 900 lb.; casing 1,220 lb. Production is through perforations at 5,961-67 ft., top of pay at 5,954 ft., and total depth 5,988 ft. Gravity of the oil is 41°.

In northwestern Starr County, 23 miles northwest of Roma, in the Sacatosa Grant, Tarver & Staggs Co. 1 Loreto Canales opened a new oil pool and was testing on the pump for completion after swabbing an estimated 20 bbl. of oil per day through perforations at 1,707-14 ft. Gravity 42°. This is an old well drilled deeper, originally completed as G. R. Boyle 1 Loreto Canales as a dry hole at total depth of 1,620 ft. Present total depth is 1,715 ft.

South extension well at Sun field, Starr County, the Sun Oil Co. 1-A Hall has been completed for 26 bbl. oil per day on gas lift, with net gas-oil ratio of 43:1, input ratio 3,000:1. Gravity of the oil is 44°. Total depth is 10,542 ft., with the 7⅝-in. casing set at 6,038 ft.

A new oil field is indicated at Roger Lacy 1 fee, wildcat test in Hidalgo County, 1 mile west of the Camerson County line, and 6 miles northeast of Mercedes. Hole is bottomed at 10,713 ft. with 5½-in. casing set at approximately 8,000 ft. for completion. On production test the well flowed 30°-gravity oil through perforations at 7,983-92 ft., using a ¼-in. choke. Operators have now squeezed and will reperforate for completion.

A new pay zone is being tested at East Alta Mesa field in Brooks County. The Standard Oil Co. of Texas 6 B. G. de Garcia (Lease 1) is testing perforations at 6,246-58 ft. and 6,262-68 ft. in sand which had showed for gas-condensate production on drill-stem test at 6,248-59 ft. Total depth is 6,740 ft., and the 7-in. casing is set at 6,451 ft.

Wildcat test in Nueces County, 1 mile northeast of Richard King field, has tested gas and spray of oil on initial production test. The Rand Morgan 1-A fee, drilled to a total depth of 5,848 ft., is testing through perforations at 5,605-09 ft., showing pressure of 1,850 lb. and casing pressure of 2,050 lb.

Four successful wildcat tests were completed this week, one gas pool in Duval, one gas-condensate in Hidalgo, and two oil pools, one each in Live Oak and San Patricio counties. There were 10 dry wildcats completed, 2 each in Duval, McMullen, and 1 each in Aransas, Goliad, Milam, Nueces, Refugio, and Webb counties. There were 14 new development starts and 4 wildcat locations. The wildcats are located one each in Bee, Hidalgo, Jim Hogg and McMullen counties.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Duval County: New gas pool—Hickok & Reynolds, Inc. 8-C J. F. Welder Hrs., 1 mi. W of Seven Sisters field, in Samuel Alexander Sur. 102, top pay 2,521 ft. (Loma Novia sand), TD 3,110 ft., perf. 2,525-27 ft., PT 3,800,000 cu. ft. gas per day on open flow, 1,010 lb. shut-in pressure.

Hidalgo County: Gas-condensate discovery, Landa pool—Stanolind Oil & Gas Co. 1 Harry Landa, in Juan Jose Trevino Porcion, Abst. 221, 6 mi. SW of Donna, top pay 8,380 ft., TD 9,512 ft., perf. 8,390-96 ft., PT 69 bbl. condensate per day through a 3/16-in. choke, and 3,005,000 cu. ft. gas per day, ratio 43,400:1, TP 2,050 lb., shut-in pressure 4,800 lb., gravity 55°, 2 bbl. per day fresh water.

Live Oak County: New oil pool — Roxie Wright et al 1 S. F. Beall Est., W. J. Cannon Sur., Abst. 141, 3½ mi. NE of Hinnant field, ½ mi. NW of Lagarto, top pay 5,580 ft., TD 6,658 ft., perf. 5,582-85 ft., PT 50 bbl. oil per day through a 3/32-in. choke, gas-oil ratio 1,790:1, TP 600 lb., CP 1,165 lb., gravity 43°, no water.

San Patricio County: New oil pool, Round Lake—Hewit & Dougherty and Lonnie Glasscock 1 W. A. Jennings (formerly 1 Lois Thornton), in John McMullen Sur., Abst. 17, 2 mi. NW of San Patricio townsite, 1¼ mi. SE of Gallagher field of Jim Wells County, top pay 5,440 ft., TD 5,869 ft., perf. 5,442-56 ft., PT 32 bbl. oil per day through a ¼-in. choke, gas-oil ratio 4,312:1, TP 120 120 lb., CP 400 lb., gravity 38°, no water.

SOUTHWEST TEXAS WILDCAT FAILURES

Aransas County: Sullivan & Garnett 1 L. M. Brock, Wm. Lewis Sur., 12 mi. NE of

Rockport on Lamar Peninsula, dry, TD 8,508 ft.

Duval County: Colonial Pet. Co. 1 Frederico Espinoza et al, BS&F Sur. 309, 10 mi. W of San Diego, dry, TD 4,715 ft.

Hiawatha Oil & Gas Co. 1 Atlee Parr, in San Andres Grant, 9 mi. SE of Benavides, dry, TD 6,005 ft.

Goliad County: Dillard & Waltermire 1 O. P. Jacobs Hrs., Peter Grass Sur., 1 mi. N of Weser, dry, TD 9,020 ft.

McMullen County: O. D. Edwards, Jr. 2 Annie Graves Dolph et al, Shumway Subd. of Shiner Ranch, in Francisco Gomez Sur., dry, TD 1,506 ft.

Henshaw Bros. and E. H. Smith 1 Nueces Land & Cattle Co., T. Roziene Sur. 166, 3 mi. NE of Munson field, dry, TD 1,854 ft.

Milam County: Trans Gulf Co. 1 Lena Fick, in J. J. Acosta Sur., near Sharp, dry, TD 1,417 ft.

Nueces County: E. A. Graham 1 Geo. E. Farenthold, Sur. 413, 4 mi. NW of Clarkwood, dry, TD 5,511 ft.

Refugio County: The Bering Co. (J. C. Wynne) 1 Walter Richter, in Johnson & Pugh Subd. of Bonnie View Ranch, In G. C. Cobian and Family Grant, 12 mi. SE of Woodsboro, dry, TD 6,687 ft.

Webb County: Newman Bros. Drlg. Co. and Skinner & Eddy Corp. 1 Rosa V. Benavides, Section 713, 4½ mi. NE of Bruni, dry, TD 3,604 ft.

TEXAS GULF COAST

Wharton County Discovery Given Gas Potential

HOUSTON.—Floyd L. Karsten's discovery gas well 1 mile northwest of production limits of the South El Campo field, Wharton County, has been given a gas potential of 3,579,000 cu. ft. daily through a ¼-in. choke with 2,425-lb. pressure while flowing and a shut-in pressure of 2,705 lb. Calculated open flow of 18,000,000 cu. ft. daily. Production is through perforations at 6,838-42 ft. Operator intends to use the gas for future exploration in the area. Several attempts were made to dually complete the well in saturated sands between 5,710-30 ft. Perforations were made from 5,710-15 ft., but water broke in with the oil each time tested.

Joyce Richardson field in Harris County has been extended 3,700 ft. by H. W. Battaile and Cecil N. Cook, Tr. 1 P. D. Maxwell et al. On initial test through perforations at 6,915-17 ft. the well flowed gas and condensate through a ⅛-in. choke, flowing pressure on tubing 1,700 lb., and 1,500 lb. pressure on the casing. Total depth is 7,605 ft. and 5½-in. casing is cemented to 7,045 ft.

Also in Harris County, Eli Marks 1 A. B. Cohn Estate, wildcat off the west flank of the Esperson dome, in Meredity Duncan Survey, prepares to make an initial test after setting 5½-in. pipe in sand on the bottom at 9,087 ft. Upper sand at 8,670-8,700 ft. is reported to have shown saturation. Two additional sands near the bottom of the hole are also reported to have saturation. Operator plans to test all three sands.

Oil production at Midfields field in Matagorda County has been extended 3,500 ft. to the southeast. Sun Oil Co. 1 Stovall, a deep test for the area, drilled to a total depth of 10,325 ft. and set 5½-in. casing 5 ft. off bottom for several deep-sand tries. After showing salt water through perforations at 10,130-41 ft., and 9,608-18 ft., hole was plugged back for completion slightly higher in the discovery sands than other wells. It flowed an estimated 75 bbl. of pipe-line oil daily through a 7/64-in. choke with 2,150-lb. flowing pressure on the tubing. Perforations are at 9,128-42 ft.

Skelly Oil Co. 1 Albert F. Gest, wildcat 1½ miles southeast of production in East Bay City field, Matagorda County, recovered sandy shale and sand streaks, having shows of oil in the breaks in core at 8,305-10 ft. Six inches of porous sand with good oil odor was recovered in core from 8,295-8,305 ft. Operators are coring ahead. The test is projected to 12,000 ft.

There were nine oil wells completed, all in proven areas, and five dry holes of which three are wildcats, one each in Colorado, Jackson and Wharton counties. The 15 locations included 2 wildcat starts, 1 each in Newton and Wharton counties.

UPPER GULF COAST TEXAS WILDCAT FAILURES

Colorado County: Tide Water Assoc. Oil Co. 1 Mrs. Ida Belle Brandon, NE of Altair, in G. W. Strawschneider Sur., dry, TD 11,451 ft.

Jackson County: Magnolia Pet. Co. 1 R. E. Lee, El Toro area, in Eliz. McNutt Sur., 4 mi. S of Edna, dry, TD 6,798 ft.

Wharton County: W. A. Clark, Jr. 1 Henry Watz, in Hutchins area, I&GN Sur., dry, TD 4,925 ft.

MICHIGAN

Tuscola County Well Causes Active Drilling Compaign

SAGINAW.—A burst of drilling activity is under way in Tuscola County on the heels of production from Fred Riddell 3 Garvin in Section 33, Arabela Township. Riddell and Ervin Major announced locations for 6 more wells in the section after completing the Garvin for 25 bbl. a day, acidized.

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gan oil and gas fields while 21 new locations were listed for drilling permits. Completion results were 7 oil producers, 5 gas wells, and 12 dry holes. Six of the dry holes were wildcats. A seventh wildcat in Klacking Township, Ogemaw County, pumped 8 bbl. a day, after acid, at 4,085 ft. Total depth was 4,143 ft. Other production came from 1 good well in Arenac, another in Isabella, accounting for most of the 1,546 new daily initial potential. Producers included two in Allegan, one in Bay, another in Isabella, the Ogemaw wildcat and the Tuscola development. Completions were recorded in 11 counties.

Other new locations in addition to Tuscola are three each in Allegan and Arenac counties, two in Kent, one each in Bay, Isabella, Montcalm, Monroe, Berrien, Gratiot and Missaukee.

MICHIGAN SUCCESSFUL WILDCAT

Ogemaw County, Klacking Township: United Drillers & Producers, Inc. 1 State-Klacking, NW SE NE 3-23n-2e, pumped 8 bbl., acidized; TD 4,143 ft., PB 4,085 ft.

MICHIGAN WILDCAT FAILURES

Allegan County, Casco Township: Smith Petroleum Co. 1 M. & E. Stevens, NE NE SW 10-1n-16w, dry in Traverse, TD 1,218 ft.

Bay County, Garfield Township: Chapman Oil Co. 1 Crapo, NE NE SE 21-16n-3e, dry in Dundee, TD 3,436 ft.

Gratiot County, Newark Township: Sohio Petroleum Co. 1 J. A. Probst, NW SE NW 34-10n-3w, dry, TD 975 ft.

Seville Township: McClure Drilling Co. 1 Ted Crum, NE NW NW 21-12n-4w, dry in Monroe, TD 3,514 ft.

Oceana County, Golden Township: L. H. Horn 1 George W. Bowen, NE SE SW 26-15n-18w, dry, TD 266 ft.

Osceola County, Burdell Township. Rowmor Corp. 1 A. B. Thomas, SE SE NW 27-20n-10w, dry in Monroe, TD 3,919 ft.

LA.-ARK.

Operators to Reperforate Chatham Field Deep Well

SHREVEPORT. — Shell Oil Co., Inc. 3 Tremont Lumber Co., Chatham gas field deep test in Jackson Parish, had total depth at 12,317 ft. in hard rock last week. Perforations at 9,208-24 ft. resulted in a slight blow of air on drill-stem test, and a recovery of 3 bbl. of mud. Flowing bottom-hole pressure was 350 lb. These holes were not squeezed but additional shots placed at 8,940-60 ft. which resulted in another slight blow with the same amount of mud. A reperforation job at 8,940-60 ft. brought gas to the surface in 3 hours, mud in the fourth hour, then salt water for 14 hours. Flowing bottom-hole pressure was 3,900 lb. Operators squeezed off all perforations and were waiting on cement.

Wildcat reports showed H. L. Hunt et al 134-F Goodpine, 9-13n-5w, Winn Parish, drilling below 7,400 ft. in lime and shale. Cores at 7,133-53 ft. recovered 3 ft. of soft lime and 2 ft. of hard gray lime with no shows. Cores at 7,153-68 ft. recovered 1 ft. of chalky lime.

In Nevada County, Arkansas, Carter Oil Co. 1 E. L. Holloway, 17-14s-21w, was waiting on pumping equipment after testing a small amount of oil from perforations at 1,184-1,202 ft. Atlas Oil & Refining Co. 1 R. A. Wynne, 8-16s-19w, Columbia County test, was waiting on pump at total depth of 6,627 ft. in lime. McAlester Fuel Co. 1 R. S. Warnock, 6-17s-19w, was drilling below 7,152 ft. in shale.

First reports in Arkansas gave Ouachita and Union counties each two, and one start each in Little River, Miller and Nevada counties. In Little River County, R. A. Mason et al 1 Troth, 3-14s-28w, was under way on a 3,500-ft. Glen Rose test. Location was based on subsurface prospecting. Miller County's 5,500-ft. test, Charles M. Kern 1 Lincoln National Life Insurance, in 15-18s-26w, was below 1,315 ft. in shale on last report.

ARKANSAS WILDCAT FAILURE

Lafayette County: Sidney G. Myers et al 1 Short, C NE SE SE 34-15s-24w, dry, TD 4,015 ft., Nacatoch 1,403 ft., Checkerboard 2,000 ft., Tokio 2,452 ft., Paluxy 2,795 ft., sand 2,874-97 ft., Massive anhydrite 3,812 ft., Basal Massive anhydrite 3,975 ft.

NORTH LOUISIANA WILDCAT FAILURE

Caddo Parish: Atlas Oil Corp. 1 Abe Meyer Corp., C SW SE 17-17n-14w, dry, TD 3,510 ft., no tops reported.

SOUTH LOUISIANA

Barnsdall Discovery Tops Louisiana Developments

NEW ORLEANS.—New oil production for the South Louisiana district was brought in by Barnsdall Oil Co. The discovery well is 1 Long Bell Lumber Co. in Section 1-6s-10w, 4 miles north of Gordon field in Beauregard Parish. Drilled to a total depth of 8,430 ft., with 7-in. casing on bottom, this test flowed at the rate of 97 bbl. of oil per day with 1,550 lb. flowing pressure, gravity 49°, through perforations at 8,236-53 ft. on a drill-stem test, using ¼-in. and 6/64-in. chokes. Testing tool is being pulled and operators will run tubing for a production gage. Production is from the Cockfield sands.

Production gage of Continental Oil Co.'s 1-mile northeast extension to gas and condensate production in the Reddell field of Evangeline Parish, has been reported. Continental's 7 Pardee in 17-4s-1w, flowed 216 bbl. of condensate, 52° gravity, in 24 hours through a 12/64-in. choke with 1,250 lb. flowing pressure on the tubing and a shut-in pressure of 3,000 lb. Gas ratio was 8,180:1. Production is from the Tate sand perforations at 9,955-80 ft. Total depth is 10,040 ft. and the 6-in. casing is cemented on bottom.

The California Co. is still trying to complete its oil discovery in the Alliance field area of Plaquemines Parish. The 1 Louisiana Citrus Lands, Inc., south and a little east of the 4 Brady Unit 4 gas discovery, on initial test flowed at the rate of 207 bbl. of pipe-line oil, 38° gravity, daily through a drill-stem test, having 1,700 lb. flowing pressure and a gas ratio of 800:1. When tubing was run for production test, it sanded up, and operators have been unable to get a completion. Pipe was reperforated from 9,750-54 ft. and squeezed with 200 gal. of plastic after which it flowed oil plus 40 per cent salt water. Pipe has now been perforated from 9,740-45 ft. for a test.

The deepest test drilled for the Four Isle Dome area of Terrebonne Parish has been abandoned after encountering salt water flow. Superior Oil Co. 2 Louisiana Land & Exploration Co., 26-21s-16e, drilled to a total depth of 11,185 ft. Salt water flow was hit at 11,174 ft., and the well was plugged. Possible shows of oil and gas were reported in sands between 11,018 and 11,026 ft. but they were not tested. New location was made for the 3 Louisiana Land & Exploration Co., in 24-21s-16e. Projected depth is 7,000 ft.

Ten development and three wildcat starts were reported this week, the wildcats being one each in Acadia, Lafayette, and Vernon parishes. One new gas-condensate sand was opened in Iberville Parish, and two dry wildcats completed, one each in Calcasieu and Iberia parishes. Terrebonne Parish received the greatest activity, receiving three completions, while Jefferson Davis, La-

fourche, and St. Martin parishes received two each.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

Iberville Parish: New gas-condensate sand, Bayou Des Glaise pool—Humble 2-B E. B. Schwing et al, 86-8s-8e, TD 11,890 ft., perf. 11,716-726 ft., PT 48 bbl. condensate per day and 2,041,000 cu. ft. gas per day through a 10/64-in. choke, gas-oil ratio 43,100:1, TP 4,250 lb., gravity 55°, no water.

SOUTH LOUISIANA WILDCAT FAILURES

Calcasieu Parish: Union Sulphur Co., Inc. 1 Brannon, 21-11s-10w, ¾ mi. SE of 1 Ellender discovery well of Bayou Choupique area, dry, TD 10,365 ft.

Iberia Parish: Union Oil Co. of California 2 Delcambre, 4-14s-5e, 5 mi. SE of Avery Island, dry, TD 12,024 ft.

PERMIAN BASIN

Coke County Discovery Shut in for Tankage

MIDLAND.—Sun Oil Co.'s Coke County discovery, the 1 Allen Jameson, has been shut in to erect storage tanks, after making a natural flow of around 100 bbl. of oil a day from the crinoidal of the Strawn section at 6,225-45 ft. Flowing pressure had increased to 325 lb. on the tubing and 900 lb. on the casing. Gas-oil ratio was said to have reached 1,618 to 1 at one time during the production. Within 24 hours after being shut in, pressures had climbed to 1,100 lb. on the tubing and 1,400 lb. on casing. Rotary equipment was being moved ¼ mile south for an offset test.

First production on the Andrews County side of the new Andector (Ellenburger) field was made last week at Humble's 1-E R. B. Cowden, when it swabbed an average of 1¼ bbl. of oil an hour. Swabbing was through tubing, from casing perforations at 8,650-60 ft. Location is ¼ mile east of the northwestern Ector County discovery. Humble's ½-mile south offset to the discovery, the 1-B Cowden, was brought in for a natural daily flowing potential of 980 bbl. of 43°-gravity oil, through ¼-in. tubing choke from perforations at 8,585-8,655 ft. Humble's 1-D Cowden, ¼-mile north offset to the discovery, was apparently headed for failure. Operators were to make a second drill-stem test after failing in the first at 7,657-7,775 ft.

Extension of Devonian production to the southeast in the Fullerton 8500 field in Andrews County was made last week by Sinclair-Prairie Oil Co. 2-160 University, SW NW Section 41, Block 13. The well made a natural daily flowing potential of 800 bbl. of 44°-gravity oil, with gas-oil ratio of 982 to 1, through 16/64-in. tubing choke. Pay zone was 8,670-8,790 ft., total depth.

Other Andrews County tests attracting interest include Fred Turner 1 Fisher-Shell, in Section 16, Block A-36, PSL Survey, and on the east side of Shafter Lake. On last report this well was at plug-back total depth of 4,456 ft. and pumping 96 bbl. of oil in 24 hours through 2-in. tubing. Union Oil Co. of California 1-F A. C. Means Estate, in Section 1, PSL Survey, 5 miles southeast of Shafter Lake, reported saturation and porosity at 4,728-56 ft. It was held up at total depth of 4,756 ft. by a fishing job. Humble Oil & Refining Co. H. O. Sims, Section 25, PSL Survey, was ready to acidize after kicking off and flowing 5 bbl. of oil the first hour, 5 bbl. the second hour and 2½ bbl. the third hour. It had been swabbed for an average of 5 bbl. of oil an hour, with fluid level 2,000 ft. from the surface.

WEST TEXAS WILDCAT FAILURES

Andrews County: Shell Oil Co., Inc. 1-E W. F. Scarborough, Sec. 11, Blk. A-31, PSL Sur., deep test in Union field, elev. 3,385 ft., dry, TD 9,714 ft. in basement complex, base Permian 8,150 ft., Montoya 8,475 ft., Simpson 8,625 ft., Ellenburger 9,380 ft., granite was 9,630 ft, base Ellenburger 9,630 ft.

Crockett County: J. P. Pringle 1 J. M. Shannon estate, Sec. 14, ELRR Sur., 5½ mi. NW of Todd Deep field, dry, TD 2,665 ft., show dead oil 2,250 ft., slight show of oil 2,318 ft., hole full of sulfur water.

Dawson County: Ray A. Albaugh 1 O. H. Morris, Sec. 32, T&P Sur., SE cor. of county, elev. 2,859 ft., dry, TD 4,005 ft., anhydrite 1,540 ft., San Andres 3,540 ft.

SOUTHEASTERN NEW MEXICO

HOBBS. — Sun Oil Co. 1-B McKinley, Hobbs field lower Permian test, Lea County, swabbed 20 bbl. of fluid in 24 hours, cutting 6 per cent sediment and 8 per cent water, from 7,543-7,658 ft. Casing pressure was 175 lb., and fluid level was 7,300 ft. below the surface.

Three new wildcats are scheduled for Lea County with work to begin in the near future. Devonian Oil Co. 1 Federal, NW NW NW 19-9s-38e, in the extreme northeast corner of the county, will go to 5,100 ft. to test the San Andres section of the middle Permian. Nearest production from that zone is the Landon pool, about 20 miles to the northeast, in Cochran County, Texas. The Texas Co. will drill its 1 W. C. Garrett, NE SE SE 22-16s-38e, to 5,000 ft. Location is 3½ miles southeast of Skelly Oil Co.'s 1 E. J. Yadon, 11-16s-37e, recently completed dry at 5,762 ft. Two miles west and slightly south of the North Lynch pool, Bay Petroleum Corp. will drill its 1 Loomis to 3,600 ft. Location is NW NE NW 23-20s-33e.

SOUTHEASTERN NEW MEXICO WILDCAT FAILURE

Lea County: Skelly Oil Co. 1 E. J. Yadon, SW NE NE 11-16s-37e, 8 mi. NE of Lovington field, elev. 3,796 ft., dry, TD 5,762 ft., anhydrite 2,130 ft., salt 2,240 ft., Yates 3,160 ft., brown lime 3,317 ft., San Andres 5,205 ft.

MISSISSIPPI

Humble Completes Fourth Mallalieu Field Producer

JACKSON.—The fourth producer for Mallalieu field, located 8 miles southeast of Brookhaven in Lincoln County, was completed by Humble Oil & Refining Co. for a daily potential of 553 bbl. of oil a day. The test, 1 M. C. Randall, in 17-6n-18e, was drilled to 10,626 ft., with casing perforated at 10,467-86 ft. Flow was through 3/16-in. choke, with gas-oil ratio of 250:1 and tubing pressure of 1,200 lb. The oil is 38°-gravity.

Humble's deep test in Lincoln County, the 1 Board of Supervisors, 16-8n-5e, was last reported coring below 10,818 ft. Previously, side-wall cores at 10,309-10,770 ft. recovered sand and sandy shale, with no shows.

In Jones County, Gulf Oil Corp.'s 1 Major, 29-6n-11w, was drilling below 6,729 ft. in chalk. In Holmes County, Skelly Oil Co. et al 1 W. M. Spann, 22-14n-1w, was said to be drilling below 5,216 ft. in hard igneous material, with sands reported very thin in the Eutaw.

MISSISSIPPI WILDCAT FAILURE

Greene County: William Helis and Union Oil Co. of California 1 A. S. Miller et al, NE NW 19-1n-7w, dry, TD 8,804 ft., Winfield 2,173 ft., Wilcox 2,405 ft., Midway 4,580 ft., conglomerate 5,584 ft., 1st Eutaw sand 7,000 ft., Tuscaloosa 7,050 ft., Marine Tuscaloosa 7,625 ft., Massive sand 8,503 ft.

Holmes County: Mid-Continent Dev. Co. 1 Sam D. Hall, dry, TD 5,864 ft., Wilcox 1,063 ft., Midway 2,765 ft., Eutaw 4,398 ft., sand 4,460 ft.

Jefferson County: The California Co. 1 W. G. Greer et al, S/2 N/2 NE SW 10-9n-4e, dry, TD 5,616 ft., Wilcox 3,225 ft.

Madison County: Kingwood Oil Co. 1 W. H. Hoover et al, SE NW NE 34-12n-3e, dry, TD 5,202 ft., Wilcox 1,225 ft., Midway 3,182 ft., conglomerate 3,962 ft., Eutaw 5,013 ft., sand 5,066-86 ft. and 5,088-142 ft.

Stone County: George Vasen 1 fee, SW NE 9-2s-11w, dry, TD 11,209 ft., Wilcox 2,616 ft., Midway 4,910 ft., 1st sand 7,022 ft., Marine Tuscaloosa 7,574 ft., Basal Marine Tuscaloosa 8,030 ft., Massive sand 8,317 ft., 1st lime 9,692 ft.

Washington County: C. H. Murphy, Jr. and Sun Oil Co. 1 J. T. Brown, NW SE 19-16n-7w, dry, TD 5,077 ft., no tops reported.

ALABAMA WILDCAT FAILURE

Coffee County: Shell Oil Co. 1 Mrs. Jane Fleming, SE SE 28-3n-19e, dry, TD 3,210 ft., no tops reported.

CANADIAN FIELDS

North Turner Valley Test Gets Madison at 7,891 Ft.

CHATHAM, Ont.—In North Turner Valley, Home-Millarville 24, a new west flank test in LSD 12, 33-20-3w5, got the Madison limestone contact at 7,891 ft. some 543 ft. higher than the recently completed No. 22. Home-Millarville 26 has been located in LSD 15, 18-21-3w5, as an outpost test to the northwest of the proven field. The field has one well making final tests, three drilling, and one potentially active location.

Medicine Hat. — In southern Alberta, Standard Oil Co. of California has supplemented its previous holdings east of the Medicine Hat gas field by securing a reservation of 39,337 acres, in Townships 12-13, Range 3w4. Plans for development have not been announced. In a drilling campaign extending over several years, California Standard has secured production in the East and West Taber, Conrad, and Steveville-Princess field, its output now aggregating in excess of 1,000,000 bbl.

Lloydminster. — Large-scale natural-gas development and substantial oil production were foreshadowed in a recent review of operations in the Saskatchewan end of the Lloydminster field by J. L. Phelps, natural-resources minister for Saskatchewan. The field, previously proven for a length of 10 miles, has been extended 12 miles to the south and southeast, and recent drilling near Buzzard, Lone Rock, and Furness has disclosed additional gas zones. Of 43 oil wells producing or standing, a majority have shown considerable gas, and there are nine gas wells capped or suspended, in addition to four producing for the town of Lloydminster. In the Lone Rock-Furnace area, gas has been struck in the Sparky sand, underlying the original Colony sand. A number of cities and towns, including Saskatoon, North Battleford, Unity, and Maidstone have granted natural-gas franchises, but the laying of lines awaits materials and the proving of additional gas reserves.

Oil production this year to the end of September totaled 120,980 bbl., against 16,508 bbl. last year. The field has 21 wells producing and 22 cemented waiting to be put in production. Six dry holes have been drilled and abandoned since operations began in 1933. More crude is in sight than the present processing plant, on the Alberta side of the field, can handle, and additions are being made. The Canadian Pacific and Canadian National railways

take about 20,000 bbl. monthly, or half the immediate production.

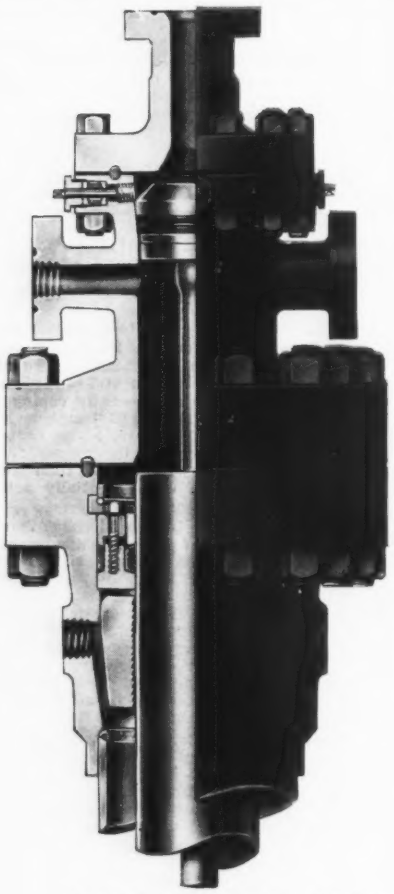
Recent wells completed to the sand are: Community 25, NE LSD 5, 13-49-28w3, total depth 1,889 ft., oil sand 1,824 ft., gas at 1,677-92 ft., 1,300,000 cu. ft.; Community 26, LSD 4, 13-49-28w3, total depth 1,848 ft., oil sand 1,826 ft., standing; Community 27, LSD 12, 13-49-28w3, total depth 1,827 ft., oil sand 1,816 ft., standing; Community 28, LSD 1, 11-49-28w3, total depth 1,873 ft., oil sand 1,851-71 ft., standing; Lyons Syndicate 2, LSD 7, 35-48-28w3, oil sands 1,866-70 and 1,876-82 ft. standing; Northeast Syndicate DB 1, LSD 6, 13-48-28w3, total depth 1,688 ft., oil sand 1,856 ft., 11,300,000 cu. ft. gas; Northern Development - Manners 1, LSD 15, 35-48-28w3, total depth 1,876-82 ft., oil 1,884 ft., standing; West-Central 1, LSD 13, 35-48-28w3, TD 1,896 ft., oil sand 1,886-06 ft., standing; Withers-Groat-Furness 25, LSD 16, 12-48-28w3, oil sand 1,840-47 ft., standing. Withers-Lone Rock 1, LSD 13, 6-47-27w3, with sands at 1,763-65 and 1,781-90 ft., is bailing with production estimated 75 bbl.

On the Alberta side, Superior-Ponalta 1, LSD 4, 14-50-2w4, to the northwest cored into the Sparky sand at 1,989 ft. with saturation at 1,992-98 ft. and is testing. Lloydbrook Syndicate 1, LSD 1, 2-51-1w4, 7 miles north of Lloydminster, after getting the lower Cretaceous, has drilled through another sand 220 ft. deeper at 1,839 ft. and looks like a good producer, marking a further extension of the field. Red Star 1, LSD 12, 11-50-1w4, finished at 1,996 ft., plugged back to perforate at 1,817 ft. and is standing capped as a gas well with 3,360,000 cu. ft.

Kinsella. — In the Kinsella field, East-Central Alberta, Imperial 22, LSD 7, 16-47-12w4, was abandoned at 2,307 ft. Imperial 24, LSD 6, 22-48-12w4, is finishing a good gasser in the Viking sand. Imperial 25, LSD 10, 10-48-12w4, is drilling.

Bruderheim.—In the Central Plains area near Bruderheim, Shunda-Bruderheim 1, LSD 5, 20-55-20w4, is finishing in the Viking sand below 1,047 ft. with prospects of commercial gas production.

Greenglade. — A new area near Greenglade just east of the Alberta-Saskatchewan boundary is being tested by Imperial Oil. Imperial-Greenglade 1 has location in LSD 5, 16-41-1w4, north and east of the Provost area.



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N. CENTRAL TEXAS

Foard County Prospect Has Oil Shows in KMA Lime

WICHITA FALLS.—Stanolind Oil & Gas Co. 1 John G. Halsell, 6 miles southeast of Crowell, in Foard County, was a prospective discovery in the KMA oolitic lime. Top of the lime was 4,617 ft., with shows of oil starting at 4,822 ft. A drill-stem test at 4,821-42 ft. recovered 80 ft. of oil and gas-cut mud. Bottom-hole pressure quickly rose to 1,800 lb. Heavy rains, which have delayed drilling in parts of North Texas, have the well shut in at total depth of 5,100 ft., bottomed in hard lime.

Four miles southwest of Montague, in Montague County, Continental Oil Co. 1 W. D. Hardison recovered 2,020 ft. of oil and 270 ft. of heavily oil-cut mud on a 1-hour drill-stem test at 6,351-62 ft. in conglomerate. A second test at 6,351-62 ft. showed gas at the surface in 2 minutes, and flowed oil in 11 minutes. It was shut in after 3 minutes' flow to core ahead.

In Clay County, Continental's Ellenburger test, 4 miles southwest of Vashti, was acidized instead of being drilled deeper as was planned, and swabbed 56 bbl. of load oil and 47 bbl. of acid water in 6 hours. Swabbing continued at 1,200 ft. from the top.

In Shackelford County, 16 miles northeast of Abilene, Stanolind 1 G. R. Davis was reported planning to test a section of the Strawn lime at around 3,600 ft. It will be plugged back from total depth of 5,200 ft. and a drill-stem test made.

In Jones County, about 2 miles southwest of Radium and in the Chittenden area, Walter and Byron Jones 1 Chittenden, reported a drill-stem test in the Flippen sand at 2,573-2,645 ft. had recovered 270 ft. of oil and gas-cut mud. Top of the sand was 2,617 ft. Casing will be run for a production test.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCAT

Wilbarger County: Paradise Oil Co. 1 W. T. Waggoner Estate I, Sec. 11, Blk. 14, H&TC Sur., 4 mi. SW of Harrold, new oil field, elevation 1,154 ft., IP flowed 60 bbl. 38°-gravity oil in 3 hr. through ¾-in. choke, limestone pay 3,138-55 ft., TD 4,964 ft. in Ellenburger, casing pressure 300 lb., tubing pressure 100 lb., GOR 600:1.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: BOM Oil Co. et al 1 Coff Conner, John W. Harris Subd., 3 mi. NW of Archer City, dry, TD 1,477 ft. in shale, no shows.

L. H. Choate 1 Burk Warmuth, Blk. 3, C&P Subd., 2 mi. SE of Scotland, elev. 922 ft., dry, TD 4,365 ft. in shale, no tops reported.

Fish & Miller 1 D. D. Strange, Blk. 5,

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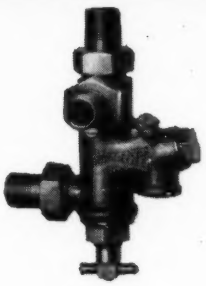

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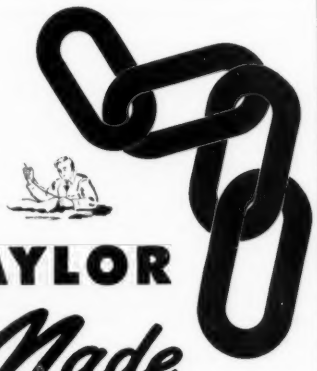

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C&P Subd., 3 mi. SE of Archer City, elev. 980 ft., dry, TD 922 ft. in sand, hard sand with show of oil 916-17 ft.

Frank Wood et al 1 C. L. Abercrombie, Blk. 157, Harris Subd., 3 mi. SW of Archer City, dry, TD 1,312 ft. in sand.

Frank Wood et al 1 C. L. Abercrombie "B," Blk. 158, J. W. Harris Subd., 2½ mi. SW of Archer City, dry, TD 1,330 ft. in sand and shale, Gunsight lime 1,229 ft.

Cooke County: Hollandsworth Drilling Co. 1 J. F. Zimmerer et al, Melbille Langham Sur., 3 mi. S of Myra, elev. 948 ft., dry, TD 2,052 ft. in hard lime.

Dwight M. Ross 1 K. B. Owens, J. Banning Sur., 7 mi. N of Muenster, dry, TD 1,927 ft. in shale, no shows.

Montague County: Jack Grace et al 2 W. L. Admire, G. W. Fisher Sur., 5 mi. N of Bonita, elev. 1,004 ft., dry, TD 5,437 ft. in shale and conglomerate, no shows.

W. H. Riddle and J. P. Ledford 1 A. Durham, F. Escobar Sur., 10 mi. S of St. Jo, elev. 976 ft., dry, TD 1,850 ft.

Throckmorton County: Fred M. Manning 1 Stanley D. Pierce, Sec. 978, TE&L Sur., 1 mi. N of Woodson, elev. 1,264 ft., dry, TD 4,042 ft., DST 4,012-37 ft. recovered 30 ft. of salty oil-cut mud.

Fred M. Manning 1 Noble Timmons, Sec. 2,163, TE&L Sur., 2½ mi. SW of Elbert, elev. 1,280 ft., dry, TD 4,306 ft., lime with show of oil 4,227-36 ft.

(Continued on page 129)

KANSAS

Barber County Wildcat Running Structurally High

GLOBE OIL & REFINING ET AL have reported their Barber County wildcat, the 1 Smith, NE NE 10-32-12w, to be checking high on all formations. The Viola was topped at 4,499 ft. and showed fair to good porosity with light staining. A 30-minute drill-stem test at 4,501-08 ft., however, resulted in the recovery of only 360 ft. of gas-cut mud and 2,400 ft. of salt water. Drilling is now progressing in the Arbuckle lime.

Continental Oil Co. is running 5-in. pipe preparatory to testing a show of oil in the Arbuckle at its 1 Mortgage, SE NE NE 3-11-18w, wildcat in northern Ellis County 1½ miles west of the Burnette pool. Top of the Arbuckle was logged at 3,617 ft. and the hole was carried to present total depth of 3,622 ft.

Meanwhile, Skelly Oil Co. is preparing to acidize the Arbuckle lime in its Ellis County prospective discovery, the 1 Allen, SE SE SW 22-11-19w. Previously this well, located northeast of the Solomon field, pumped 35 bbl. of oil with no water from the Arbuckle at 3,641-45 ft.

Two new wildcats were announced for Rush County during the past week to bring that county back into the Kansas exploratory picture. The Huber and Wakefield 1 Pelz has been staked in NE NE NE 10-17-19w. This is a rank wildcat test in the western part of the county and about 14 miles southwest of nearest production in the Schoenchen pool of Ellis County. In the eastern part of the county, Skelly et al have rig in place for the 1 Dirks, NE NE SW 7-18-16w, 2 miles west of the Otis gas field. Skelly, Lion and Sunray communitized the section on which this test will be drilled, Skelly contributing half the acreage and Lion and Sunray each one quarter.

KANSAS WILDCAT FAILURES

Cowley County: Drillers Gas 1 Shaup, SE SE SW 16-31s-3e, dry, TD 3,500 ft., Kansas City 2,553 ft., Mississippi lime 3,145 ft., Basal Mississippi lime 3,395 ft., Arbuckle 3,485 ft.

Mitchell County: Olson Drilling et al 1 Palen, NW SW SE 26-8s-10w, dry, TD 4,205 ft., Ft. Riley 1,605 ft., Heebner

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Sheridan County: Stanolind Oil & Gas 1 Thompson, NW NW SE 10-8s-29w, dry, TD 4,745 ft., Mississippi lime 4,547 ft., Arbuckle 4,694 ft.

CALIFORNIA

Northwest Wildcats Hold West Coast Interest

LOS ANGELES. — Rank-wildcat territory of the Pacific Northwest, covering portions of Washington, Oregon, and the northwestern California coastal area continues to attract "long-shot" exploratory prospects as West Coast oil companies respond to the urgency of discovering new prolific oil production.

Out of 15 discoveries in California in 1946 classified as new fields, three are definitely dry-gas reservoirs and not a single one of the 12 oil fields ranks as of more than minor importance. New pools or new plays under previously existing fields at Wilmington and Elk Hills prevented 1946 discoveries from falling to the lowest level in the history of California's oil industry.

In view of discouraging discovery results in areas more closely related to existing West Coast fields, the authorization of "long-shot" exploratory operations in the uncharted areas of Washington, Oregon and Northern California is not surprising.

In step with this trend to venture into relatively unknown territory, Standard Oil Co. of California last week authorized a new wildcat in the vicinity of Martha Lake, 8 miles northeast of Edmonds, Wash., where drill site is being made ready for 1 Alderwood in Section 35-28n-4e. This will be the third wildcat drilled in Washington by Standard of California. The company drilled a dry hole in Moclips area near Aberdeen in 1920 and this year abandoned another unsuccessful try at Ferndale after drilling to 6,230 ft.

The third try for production by The Texas Co. is The Texas Co. 6-1 Clark and Wilson, about 40 miles northwest of Portland in Section 19-6n-4w, Willamette base meridian in the Mist area. The Clark and Wilson test is about 10 miles from the Cooper Mountain failure abandoned a few weeks ago and about 12 miles south of Clatskanie where The Texas Co. drilled its first unsuccessful wildcat in Oregon.

Union Oil Co. of California has done considerable leasing and preliminary exploratory work in Oregon, and the company's 1947 program calls for start of test drilling.

A hundred miles south of the Oregon-California line, The Texas Co. is drilling another wildcat in the Hydesville area, Humboldt County. The test, 1 Anderson, 8-2n-1e, now drilling at 4,500 ft., is approximately 15 miles southeast of the company's previous exploratory-drilling operations in the Holmes-Eureka area.

Unsuccessful efforts to free stuck drill pipe in Pacific Western Oil Corp. 1 National Royalties at 16,668 ft., the world's deepest well, in 5-26s-22e, Kern County, temporarily damped interest in this project. Apparently pipe is free from the surface to 16,300 ft., and efforts are continuing to free the drill collars and bit.

Prospects for major production in the Alondra area, Potrero field, West Los Angeles, were subordinated last week by disappointing results in two tests, follow-ups to the discovery well. The Texas Co. and Seaboard Oil Co. 9-1 Gardena Community, 26-3s-14w, ½ mile southeast of the discovery well, was coring and drilling below 9,702 ft. The step-out well was in the Conglomerate - Schist zone which produced in the discovery from 9,087 to 9,154 ft., but core recovery in the extension was gray and unencouraging. Likewise, British American Oil Producing Co. 1 Alondra Park, 22-3s-14w, a deflected hole under park property offsetting the discovery, obtained a negative "wet" test from 9,230-53 ft.

Meanwhile, a fourth drilling operation for Alondra, British-American and Texas 2 Bodger, also in 22-3s-14w, spudded to explore structural conditions in another offsetting direction to the discovery.

CALIFORNIA SUCCESSFUL WILDCAT

Humboldt County: The Texas Co. 3 Holmes-Eureka, 22-3n-1w, 5,000,000 cu. ft. gas; shut-in, TD 7,850 ft.

CALIFORNIA UNSUCCESSFUL WILDCATS

Kern County: East San Emidio Oil Land Co. 1 Barlow, 30-31s-30e, dry, TD 1,450 ft.

Jergins Oil Co. 68-8 KCL, 8-29s-27e, dry, top lower Kernco, 4,480; top Santa Margarita, 4,645; TD 4,667 ft.

Tulare County: General Petroleum Corp. 42-30 Moran, 30-22s-26e, dry, top Schist 4,480, TD 4,648 ft.

United Exploration Co. 1 Monroe United, 12-18s-23e, oil stained sand 3,590-3,617, top hard slate 3,810, dry, TD 3,836 ft.

Fresno County: Union Oil Co. 75-19 SPL, 19-16s-17e, dry; top Zilch shale 6,095, Kreyenhagen 7,597, Domengine 8,184-97, Weyant sand 8,272, Martinez 8,296, Cretaceous 8,444, Wheatville sand 8,467, TD 8,492 ft.

Santa Barbara County: General Petroleum Corp. 1 Goodwin, 10-9n-35w, mechanical difficulty, dry, TD 4,673 ft.

OKLAHOMA

Exhausted Wilcox Oiler Flows Large Volume of Gas

THE Sinclair-Prairie Oil Co. 1 Franks, NW NW NE 35-9n-6e, an exhausted Wilcox oil well, surprised operators who were pulling casing during the past week when it came to life and flowed an estimated 7,000,000 cu. ft. of gas. The well was drilled to the Wilcox in 1926 and had been dead for more than 4 years with casing pulled to 2,338 ft. when operators went into the well to pull the remainder of the pipe late last week. While loosening the pipe to that depth, the well suddenly blew in and a crew had to be called in to help control and shut the well in. Located in the Seminole pool of the Greater Seminole field, the 1 Franks may indicate the presence of a rich gas reservoir in the old field.

The four oil pools in Cotton County, all opened since last April, averaged 8,357 bbl. of oil daily during the past week from 246 wells to give that county the largest percentage gain in production of any Oklahoma County. Production by pools was: Cache Creek 5,745 bbl., East Cache Creek 335 bbl., Essaquanahdale 310 bbl., and Soldier Creek 1,967 bbl. In spite of a dry hole ratio of about 25 to 1, drilling activity is continuing at a high level and operators estimate the play will probably continue for another 6 months.

OKLAHOMA SUCCESSFUL WILDCATS

Garvin County: Magnolia 1 Osborne, NE SE NE 24-4n-3w, extension to Southwest Mayesville pool, flowed 1,230 bbl. of 42.3°-gravity oil per day from Bromide sand at 7,379-82 ft., anhydrite 4,895 ft., sandy lime 6,580 ft., 1st sand 7,290 ft., TD 7,435 ft.

Seminole County: Sam Trant 1-A Pipkin, NE NE SW 2-10n-6e, new pay zone in Keokuk pool, flowed 54 bbl. of 40.4°-gravity oil through ⅜-in. tubing choke from Calvin at 2,630-45 ft., TD 2,645 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: L. H. Choate 1 Knight, SW SW NW SW 26-3s-10w, dry, TD 1,606 ft., no tops reported.

E. Shamblin et al 1 Wolfe, SE SE NW 11-4s-12w, dry, TD 2,545 ft., sand 1,372-76 ft., sand and lime 1,694-715 ft. and 1,872-911 ft.

Griffin & Barbre 1 Gore, SW SW SW

(Continued on page 138)

OHIO, KENTUCKY

Muskingum County Wildcat Completed as Large Gasser

COLUMBUS.—The Four Way Oil and Gas Co. brought in a gas well 3 miles east of the field in Blue Rock Township, Muskingum County. The wildcat, on William D. Miller, Section 36, found the Clinton at 4,660-92 ft. with a natural gage of 4,257,000 cu. ft. at 4,679-88 ft.

On their third attempt, Theiss et al discovered gas in Orange Township, Meigs County, 4 miles north of the Chester Township discovery. The test was on Coy C. Hawk, Section 17, and made 500,000 cu. ft. natural in the Berea sand at 1,641-44 ft. In Chester Township, Mathews Oil 1 Charles C. Reed, Section 14, came in at 758,000 cu. ft. with a rock pressure of 740 lb. to extend the new pool a location to the north. The Berea sand was found at 1,630-35 ft.

Southwest of Somerset, John Morrow et al 4 W. E. James, Section 18, Reading Township, Perry County, came in at 1,629,000 cu. ft. natural. Clinton, topped at 2,798 ft., was drilled to 2,813 ft. and tubed.

The Canton field is still active with 12 new locations reported this week. Brush Creek reported eight, followed by Ashland with four. Cambridge, Lancaster, and Stewart with three each. Cambridge field led in completions with seven.

OHIO SUCCESSFUL WILDCATS

Meigs County, Orange Township: Theiss et al 1 Coy C. Hawk, Sec. 17, Barea 1,641-44 ft., 500,000 cu. ft., TD 1,644 ft.

Morgan County, Deerfield Township: Industrial Gas Corp. 2 H. H. Banks, Sec. 20, Clinton 3,997-4,027 ft., 25 bbl., TD 4,033 ft.

Muskingum County, Blue Rock Township: Four Way Oil & Gas Co. 1 Wm. D. Miller, Sec. 36, Clinton 4,660-92 ft., 4,257,000 cu. ft., TD 4,692 ft.

OHIO WILDCAT FAILURES

Columbiana County, St. Clair Township: Frank Brendel 1 H. C. Johnson, Sec. 18, Oriskany 4,538-44 ft., TD 4,544 ft.

Licking County, Newton Township: Ohio Fuel Gas Co. 1 A. Lingafelter, 3 Qr., Clinton 2,308-24 ft., TD 2,340 ft.

EASTERN KENTUCKY

ASHLAND.—One dry hole on the William Newsom property, Floyd County, and a completion with a total of 198,000 cu. ft. of gas in shale, Big Lime and Maxon sand, were noted during the past week.

Kentucky-West Virginia Gas Co. completed well No. 5,673 at 3,275 ft. as a dry hole.

Kentucky-West Virginia Gas Co. completed well No. 5,687, James M. Miller property, Pike County, at 3,840 ft. Production was 58,000 cu. ft. in shale, 21,000 cu. ft. in Big Lime and 119,000 cu. ft. in Maxon.

WESTERN KENTUCKY

OWENSBORO. — Exploratory activity in the western Kentucky area remained at a low level during the past week, with no wildcats reaching crucial stages of development. Six completions were reported for the week and included four oil wells and two dry holes. Only one wildcat completion, a dry hole in Henderson County,

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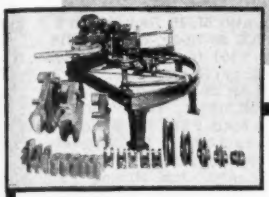

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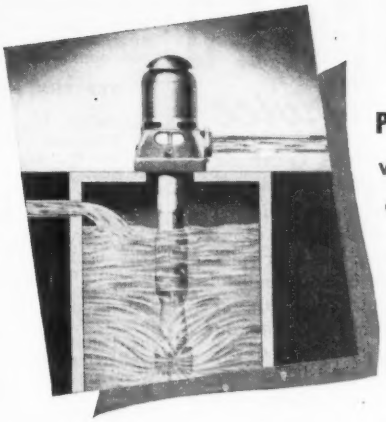

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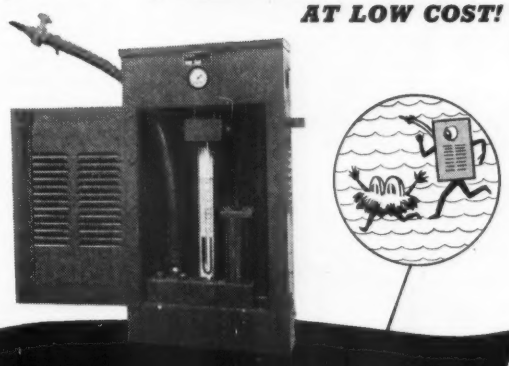

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was reported. New operations announced during the week totaled six and included three in Union County, two in Henderson and one in Daviess.

WESTERN KENTUCKY WILDCAT FAILURE

Henderson County: Carter Oil 1 Henry Blackwell, NW SE SW 7-O-23, elev. 466 ft., dry at 2,785 ft., Glen Dean 2,000 ft., Ste. Genevieve 2,566 ft.

INDIANA

EVANSVILLE.—In the New Harmony East pool of Posey County, a recently opened area now containing four oil wells, Central Pipe Line Co. is completing a good well at the 1 R. & H. Pote, NW NE NE 18-5s-13w. Saturation was encountered in the Palestine sand at 1,976-93 ft. and the Waltersburg sand at 2,110-21 ft., total depth. When the special alloy casing was removed opposite the Palestine section, the well started flowing and last gage taken before closing the well in for tankage indicated it to be making 25 bbl. of oil an hour from the two pay zones.

Seven completions were reported for the Indiana fields during the past week, five of them being oil wells and two dry holes. Only one wildcat, a Cypress sand discovery in Gibson County, was completed. Twelve new operations were announced during the week, of which six were in Posey County, five in Gibson and one in Pike.

INDIANA SUCCESSFUL WILDCAT

Gibson County: Henry Smith et al 1 Owen Beloat, NW NW 8-2s-10w, pumped 170 bbl. oil and 200 bbl. water daily, Cypress sand 1,827-30 ft., TD 1,841 ft., PB 1,836 ft.

ILLINOIS

Clark County Wildcat Pumping 10 Bbl. Daily

MATTOON.—A new oil field 2 miles northeast of the old Casey pool in Clark County is in prospect at the Collins Bros. 1 Baker, NE NE SE 30-10n-14w. After encountering saturation in the Casper sand at 1,326-36 ft., the well was put on pump and is now making 10 bbl. of oil and 20 bbl. of water daily. Drilled to a total depth of 1,572 ft., the well has been plugged back to 1,430 ft. If the 1 Baker is successfully completed, it will be the first discovery in Clark County since the present Illinois basin play started in 1936. All other fields in the Clark County area are old fields, the majority of them being discovered in the period from 1906 to 1910.

In Moultrie County, Ben J. Taylor is installing pumping equipment to test his prospective Aux Vases discovery, the 1 John D. Hardinger, SW SW NE 21-12n-6e. On previous tests the well produced ½ bbl. oil and 1½ bbl. of salt water per hour from the Aux Vases at 1,933-67 ft. Total depth is 2,011 ft.

Illinois completions totaled 46 for the past week, a gain of 9 over the previous week. Included in the total were 19 oil wells and 27 dry holes. Wildcat completions totaled 13, only 1 of which was successful. New work continued at a high level during the week, with locations announced for 53 new operations, of which 15 were for exploratory tests.

ILLINOIS SUCCESSFUL WILDCAT

Wayne County: Texas 1 E. Hines "C," SE SE SE 1-1s-9e, pumped 190 bbl. daily, Levias 3,254-62 ft., TD 3,263 ft.

ILLINOIS WILDCAT FAILURES

Clay County: Paul Doran 1 W. Hamilton, SE SE SW 32-5n-5e, dry at 2,689 ft., Glen Dean 2,045 ft., Cypress sand 2,260 ft., Benoist 2,412 ft., Aux Vases 2,464 ft., Ste. Genevieve 2,546 ft., Rosiclare 2,560 ft., St. Louis 2,675 ft.

Effingham County: R. A. Gould & Co. 1 Kabbes, SW SE NW 22-9n-6e, dry at 2,427 ft., Tar Springs 1,814 ft., Cypress sand 2,049 ft., Benoist 2,199 ft., Aux Vases sand 2,260 ft., Ste. Genevieve 2,316 ft., Rosiclare 2,328 ft., McClosky 2,364 ft.

National Associated Petroleum Co. 1 V. Colton, NE SE NW 15-7n-5e, dry at 2,414 ft., Glen Dean 1,891 ft., Ste. Genevieve 2,331 ft., Fredonia 2,361 ft., McClosky 2,403 ft.

Fayette County: M. H. Richardson 1 F. Zinn, SE SE NE 26-7n-2e, dry at 1,818 ft., Tar Springs 1,556 ft., Glen Dean 1,656 ft.

Gallatin County: Shafer-Toler 1 E. A. Green, NW SW SE 22-8s-9e, dry at 3,015 ft., Tar Springs 2,202 ft., Glen Dean 2,231 ft., Cypress sand 2,516 ft., Benoist 2,675 ft., Aux Vases 2,806 ft., Ste. Genevieve 2,863 ft., McCloskey 2,923 ft.

Hamilton County: Opal Hinson 1 Campbell, SW NW NW 9-6s-5e, dry at 3,517 ft., Tar Springs 2,652 ft., Glen Dean 2,720 ft., Cypress sand 3,006 ft., Benoist 3,174 ft., Ste. Genevieve 3,331 ft., McClosky 3,435 ft.

Jefferson County: H. Haughton 1 Inland Steel, SW SW NE 35-4s-1e, dry at 2,992 ft., Glen Dean 2,270 ft., Cypress sand 2,498 ft., Aux Vases sand 2,773 ft., Ste. Genevieve 2,827 ft.

Lawrence County: Evans & Hartsorne 1 H. Jones, NE SW NW 29-2n-13w, dry at 2,831 ft., Benoist 2,585 ft., Renault 2,636 ft., Ste. Genevieve 2,690 ft.

Washington County: C. E. Brehm 1 Bernrenter, NE NW SE 4-1s-3w, dry at 1,467 ft., Glen Dean 885 ft., Cypress sand 1,096 ft., Benoist 1,200 ft., Aux Vases sand 1,312 ft., Ste. Genevieve 1,394 ft.

Wayne County: A. J. Slagter, Jr., 1 T. Marshall, NW NW SE 36-2n-6e, dry at 3,300 ft., Glen Dean 2,627 ft., Aux Vases 3,152 ft., Ste. Genevieve 3,175 ft., McClosky 3,225 ft.

R. B. Martin 1 French, SW SW SE 24-1n-9e, dry at 3,352 ft., Glen Dean 2,627 ft., Aux Vases 3,152 ft., Ste. Genevieve 3,175 ft., McClosky 3,225 ft.

White County: National Associated Petroleum Co. 1 A. Artin, NW NW NW 32-4s-8e, dry at 3,558 ft., Cypress 3,068 ft., Benoist 3,335 ft., Levias 3,408 ft.

ROCKY MOUNTAIN

North Cut Bank Extended Southward

DENVER.—An extension of the Madison lime producing area in the North Cut Bank field in Montana a distance of 2½ miles to the south may be expected as a reasonable certainty following results disclosed in Union Oil Co. 7 McGuinness Unit, SW NE NW 6-35s-5w. This well flowed for 9,600,000 cu. ft. of gas in the Cut Bank sand at 2,827-68 ft. At that depth it was decided to have a look at the Madison lime before completing it. It had 49 ft. of saturated Madison at 3,035-84 ft., and stopped drilling at 3,089 ft. Fluid rose 1,500 ft. in the hole and on a swabbing test it produced at the rate of 65 bbl. of oil per day. The crude tested 40° gravity as compared with 37° to 39° in the wells farther north. Following the short test, the hole was plugged back to 2,895 ft., and completed as a gasser in the Cut Bank sand. Rig then was skidded to SW NW NW Section 6 for 8 McGuinness Unit to test the Madison horizon independent of the gas sand. The new well is 5 miles south of the discovery in the Madison lime, Carter Oil Co. 1 Brindley. Two groups of producers have been developed to the north of the McGuinness well, one around the Brindley discovery and the other midway between the discovery and the McGuinness extension. The intervals between these groups have not been tested.

SUMMARY OF NOVEMBER COMPLETIONS

	Comp.	Oil	Prod.	Gas	Dry	Under 1,000 ft.	1,000-2,500 ft.	2,500-5,000 ft.	5,000-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	121	60	197	0	*61	0	121	0	0	0	177,973	139
Pennsylvania	298	149	233	23	†126	16	255	27	0	0	443,126	233
West Virginia	63	11	59	40	12	1	33	25	4	0	175,006	251
Ohio	116	19	490	54	43	0	18	98	0	0	332,603	222
Indiana	29	16	1,096	0	13	3	15	11	0	0	62,545	62
Kentucky	43	10	681	19	14	4	23	16	0	0	92,968	58
Illinois	214	116	16,651	1	103	8	72	133	1	0	551,974	260
Michigan	62	14	795	11	†37	3	35	24	0	0	136,281	131
Kansas	174	76	17,990	34	‡64	1	20	152	1	0	556,601	367
Neb., Mo., Iowa	3	0	0	0	3	1	1	1	0	0	5,352	10
Oklahoma	331	181	30,773	35	§115	7	162	123	36	3	942,941	497
Texas	601	359	75,292	38	204	42	123	194	229	13	2,678,386	954
North	129	71	7,139	2	56	26	42	46	15	0	359,832	225
West Central	62	27	2,833	1	34	5	29	26	2	0	165,535	53
West	164	121	47,714	6	37	8	31	55	64	6	763,806	153
Panhandle	15	10	729	3	2	0	2	13	0	0	43,720	96
Eastern	38	15	2,481	13	10	0	0	13	25	0	211,027	94
Upper Gulf Coast	64	37	5,634	6	21	0	1	14	44	5	440,096	120
Lower Gulf Coast	75	56	7,356	6	13	0	1	8	64	2	493,509	136
South	39	14	896	1	24	0	13	15	11	0	144,746	38
South Central	15	8	510	0	7	3	4	4	4	0	56,115	39
Louisiana	139	84	12,670	8	47	0	25	48	44	22	819,826	218
Northern	79	47	6,527	8	24	0	23	40	16	0	297,061	90
Southern	60	37	6,143	0	23	0	2	8	28	22	522,765	128
Arkansas	15	9	1,232	0	6	0	5	8	2	0	52,217	36
Mississippi	28	18	5,764	1	9	0	0	2	17	9	229,050	78
Ala., Ga., Fla.	5	0	0	0	5	0	1	2	2	0	20,769	20
Montana	38	15	1,090	14	9	0	22	15	1	0	87,019	60
Wyoming	18	18	3,839	1	3	1	0	13	4	0	71,462	79
Colorado-Utah	22	20	6,516	0	2	0	1	0	21	0	135,442	72
New Mexico	31	18	6,356	7	6	1	7	10	13	0	129,421	110
California	165	133	25,759	6	26	1	49	65	46	4	677,838	215
Total November	2,516	1,316	207,483	292	908	89	988	967	421	51	8,378,000	4,072
Total October	2,683	1,427	257,614	324	932	119	1,011	1,070	419	64	9,004,275	4,077

Service wells: *61, †124, ‡3, §1.

Grass Creek revival.—The Grass Creek field, Hot Springs County, Wyoming, which has produced approximately 29,000,000 bbl. of light oil and 6,000,000 bbl. of heavy oil since its discovery 32 years ago, is to be operated as a unit after January 1, 1947, with Ohio Oil Co. as the operator. Efforts to unitize the field have been under way for several years and were attended with considerable difficulty due to the scattered royalty and other interests which dated back to the boom days of Salt Creek, Grass Creek and Elk Basin prior to discovery in 1914. Practically all of the developed area of the field, except for a minority interest held by Kinney-Coastal Oil Co., is owned by Ohio Oil Co. and Stanolind Oil & Gas Co.

Mush Creek extended.—Mush Creek Oil Co. has brought in a producer in its 2 Smith, NW NW NE 15-44n-63w, Mush Creek district, Weston County, northeastern Wyoming, which may be a discovery, but probably an extension of a discovery made in 1944. It had the top of the Newcastle (Muddy) sand at 4,003 ft., with a show for 500,000 cu. ft. of gas, and was drilled to 4,019 ft. where it began flowing. It made approximately 100 bbl. in 8 hours when it was shut in for tankage. On last gage reported it flowed 77½ bbl. in 18 hours, the oil testing 41.7° gravity. The well is located 2½ miles northwest of Western Oil Trust 1 Millhouse, SW NE SW 24-44n-63w, which drilled intermittently from 1938 to the spring of 1944, and was completed in the Newcastle sand at 3,852-55 ft., the latter being the total depth, flowing 80 bbl. in 24 hours. Two years later it was still making 25 bbl. per day of 38.5°-gravity oil.

Completions.—Sixteen wells were completed, of which seven were oil wells with initial production of 498 bbl., five were gas wells, and four were dry holes. Colorado completions included one producer in the Rangely field for 281 bbl. and two wildcats in Baca County, which were dry. One of the latter was Sharples-Frontier-Huber 1 Jacobson, SE SE 28-29s-50w, the second of three wells being drilled in the Freezeout district to test the possibilities of a stratigraphic trap. It was plugged and abandoned at 3,622 ft., the elevation being 4,903 ft. The Wyoming completions included four oil wells for 170 bbl., one in Big Muddy, two in Osage and one the Mush Creek wildcat described above. Montana completions included two oil wells in Kevin-Sunburst, three gas wells in Cut Bank, Cedar Creek and Bowdoin, and one dry hole in Cut Bank. Northwest New Mexico had two gas wells completed in Fulcher Basin and a dry wildcat in San Miguel County.

COLORADO WILDCAT FAILURES

Freezeout, Baca County: Sharples-Frontier-Huber 1 Jacobson, SE SE SE 28-29s-50w, TD 3,622 ft., plugged and abandoned. tight hole until last of three tests are completed.

Springfield, Baca County: Skelly Oil Co. 1 Glasgow, NW NW NW 22-33s-44w, TD 5,629 ft., plugged, top Day Creek 790 ft., Blaine 1,151 ft., Lansing-Kansas City 3,494 ft., Mississippi lime 5,462 ft., small show of oil at 3,705-87 ft., elev. 4,087 ft.

WYOMING SUCCESSFUL WILDCAT

Mush Creek, Weston County: Mush Creek Oil Co. 2 Smith, NW NW NE 15-44n-63w, TD 4,019 ft., top Newcastle sand 4,003 ft., flowed 100 bbl. 41.7-gr. oil in 8 hours, last gage 77½ bbl. in 18 hours.

NORTHWEST NEW MEXICO WILDCAT FAILURE

Wildcat, San Miguel County: Phillips Petroleum Co. 1 Leatherwood, NW NE SW 2-15n-18e, TD 2,730 ft., abandoned in granite.

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Among the Drilling Contractors

Meeks & Beardslee have been assigned contract to drill the Bannatyne Oil Syndicate 1 Speer, NW NW SE 5-25n-1e, Teton County, Montana. The 1 Speer will be a Devonian test in the old Bannatyne field.

Rowan Drilling Co. last week applied for permit to deepen its 2 J. E. Parker from present total depth of 8,464 ft., to around 10,000 ft. to explore the Ellenburger. Located at the southeast end of the TXL field, Ector County, West Texas, it was said to have shown for possible production in the upper Devonian.

Helmerich & Payne, Inc., has contract for Richfield Oil Corp. 1 McMillan Unit, NW SE NE 36-20s-36e, 8 miles northwest of Carlsbad, central Eddy County, New Mexico. Material was being moved in last week, with cellar and pits completed.

Commonwealth Drilling Co., of Calgary, Alta., has completed the important Sun-C.P.R. 1, LSD 11, 8-18-16w4, in the Eyremore district of southern Alberta. Drilled 217 ft. into the Jefferson limestone at 4,893 ft., the well proved noncommercial, but other wells are to be drilled.

George P. Livermore, Inc., was rigging up rotary last week at Richfield Oil Corp. 1 Comanche Unit, 15 miles east of Roswell, east Chaves County, New Mexico. Location is SW NW NE 13-11s-26e, and contract depth is 6,500 ft. The same operators will deepen Honolulu Oil Corp. et al 1 Mullis, in south Chaves County, some 19 miles east of Lake Arthur, from old total depth of 5,675 ft., to around 10,000 ft.

Boyles Bros., drilling in the tar sand area 25 miles north of McMurray, Alta., lost a drilling rig by fire when gas unexpectedly blew in at 200 ft. and was ignited from a gasoline lantern. Two of the crew, Gordon Fraser of Fort Chipewyan, and Morris Allen of Vancouver, suffered burns.

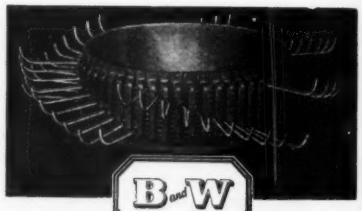
Severens Drilling Co., Los Angeles, is moving in equipment to drill British-American Oil Producing Co. and The Texas Co. 2 Bodger, second joint operation for the drillers of the discovery well in the new Alondra field in western Los Angeles County, California. Location for 2 Bodger is 1,213 ft. north and 1,047 ft. west from south quarter corner of Section 22-3s-14w.

Snyder & Head, of Calgary, Alta., have contract with Berry Creek Petroleums, headed by E. G. Lawrence, for a test in LSD 3, 9-31-14w4, a half mile south of Hanna, Alberta. Rotary outfit is rigged, to spud early in 1947. The test is for gas, the Lawrence interests having secured a franchise for the town of Hanna.

Calvert & Willis, Olney, Ill., are contractors on three tests in Illinois and Indiana, as follows: (1) Inland Producers, Inc., 1 Owens, in 5-6s-6e, Hamilton County, Illinois; (2) J. J. Lynn 1 Moore, east of Enfield, in White County, Illinois, and (3) Sun Oil Co. 1 Fred D. Wiley, in 18-5s-13w, Posey County, Indiana.

General Petroleums, of Calgary, Alta., has contracts for two wells to be drilled for Beacon Petroleums, Ltd., and Rex Syndicate in the Lloydminster field, Alberta. Drilling on centrally located acreage will start about February 1, 1947.

Rocky Mountain Drilling Co., Los Angeles, has been awarded contract by Standard Oil Co. of California for



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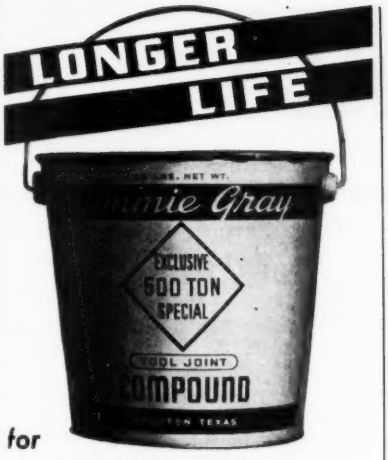

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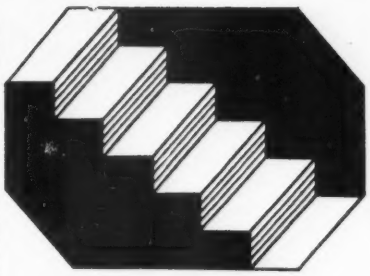
its new Washington wildcat, 1 Alderwood, about 10 miles from Everett, Wash. Equipment for the drilling assignment was shipped from Los Angeles last week. Location is approximately 450 ft. north and 500 ft. east from the southwest corner of Section 35-28n-4e, Snohomish County, Washington.

Sam Tennant Drilling Co., of Blackwell, Okla., is rigging up rotary tools for a test in SE NE SW 30-27n-2e for Russell Maguire, of Wichita, Kans.

Miller and York, Bakersfield, have contract for drilling Pacific Oil & Gas Development Corp. 73-22 Cantleberry, 1,650 ft. south and 990 ft. west from the northeast corner of Section 22-25s-27e, Kern County, California. Location is practically a southeast offset to Pacific Oil & Gas 72-22 Cantleberry which was completed last July for 84 bbl. daily of 13.5°-A.P.I. gravity crude from the interval at 2,769 to 2,794 ft. as the discovery well in the Jasmine field. The new well to be drilled by Miller & York is the first started since discovery of the field.

Hercules Well Shooting Co. is working on contract to complete and test Alliance 1, LSD 15, 19-20-1w4 in the Antelope Hills area, in eastern Alberta. The well, finished around 3,930 ft., is making water shutoff preparatory to testing oil showings.



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HOUSTON, TEXAS

California Fields

(Continued from page 123)

Wichita County: A. R. Dillard 1 Waggoner "B," Robert Evans Sur., 2 mi. W of Wichita Falls, elev. 962 ft., dry, TD 5,510 ft., Caddo 5,233 ft., Ellenburger 5,404 ft.

Young County: Jerome McLester 1 J. A. Allen, N. Lynch Sur., 2 mi. NE of Graham, elev. 1,132 ft., dry, TD 2,240 ft., sand with show of oil 2,238-39 ft.

WEST CENTRAL TEXAS SUCCESSFUL WILDCAT

Eastland County: Cities Service Oil Co. 1-B W. T. Hittson, Sec. 2, SPRR Sur., 5½ mi. NE of Cisco, elev. 1,509 ft., IP flowed 84 bbl. 42°-gravity oil a day, Lake sand 3,343-58 ft., 10/64-in. choke, tubing pressure 700 lb., casing pressure 500 lb., GOR 678:1, TD 3,358 ft.

WEST CENTRAL TEXAS WILDCAT FAILURES

Haskell County: Thomas D. Humphrey 2 E. O. Chapman, H. Tidwell Sur. 60, 7 mi. NE of Haskell, elev. 1,495 ft., dry, TD 4,284 ft., Strawn sand with show of oil 4,265-70 ft., recovered 400 ft. salt water in 1 hr.

Thomas D. Humphrey 1 J. L. Collier, J. E. Ellis Sur., 8 mi. E of Haskell, elev. 1,491 ft., dry, TD 4,534 ft. in shale and lime, no shows or tops reported.

Taylor County: Sojourner Drilling Co. 1 Sealy-Smith Foundation, Blk. 147, Grimes CSL, 2 mi. SE of Merkel, elev. 1,863 ft., dry, TD 3,205 ft., Saddle Creek lime 2,525 ft., Flippen 2,574 ft., show of oil 2,574-86 ft., Gunsight 2,855 ft., Reef lime 3,025 ft.

Jones County: S. D. Johnson and Russell Maguire 1 F. E. Olsen, 5 mi. SE of Stamford, elev. 1,523 ft., dry, TD 3,399 ft., Home Creek 2,335 ft., Adams brown lime 2,747 ft., Palo Pinto 3,307 ft.

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PERSONALS

Max Ball Named OGD Head Succeeding Ralph K. Davies

MAX W. BALL, who this week was scheduled for appointment as director of the Oil and Gas Division, Department of the Interior, is a geologist, attorney, and a veteran of wide experience as an executive in the oil industry. He will succeed Ralph K. Davies, acting director of OGD since its conception earlier this year.

Now 61, Ball first entered public service in 1906, after graduating from the Colorado School of Mines, when he joined the U. S. Geological Survey. Four years later he became chairman of the oil board and served as such until 1916, when he became mining engineer and law officer of the Bureau of Mines. He had received his master of laws degree from National University in Washington in 1914.

In 1917 he became chief geologist in the Rocky Mountain division of Roxana Petroleum Co. of Oklahoma and a year later became general manager of Royal Dutch-Shell oil interests in the Rocky Mountain region.

Ball was president of Western Pipe Line Co. from 1921 to 1927 and during that period also served as president of Marine Oil Co. and associated companies and Argo Oil Co. He began a consulting practice in 1928, serving simultaneously as an executive in several petroleum concerns.

In 1944, he became a special assistant to Davies who was deputy petroleum administrator for war. On several occasions, he acted as liaison man for PAW in presentations to the Senate committee investigating petroleum resources.

Ball, whose home is in Denver, is author of "This Fascinating Oil Business," a popular book on the oil industry. Before the war, he spent 7 years near Edmonton, Alta., working on a project to produce oil synthetically from tar-sand deposits. He recently has been associated with Michigan Consolidated Gas Co.

Urban M. Warren, formerly production foreman at Long Beach for Shell Oil Co., Inc., has been transferred to Bakersfield and assigned similar duties in the San Joaquin district.

James E. Low, formerly production superintendent for Amerada Petroleum Corp., covering West Texas and New Mexico, has been transferred to Fort Worth where he will be division production superintendent. **Joe O. Hathaway** replaces Low as production superintendent at Midland, Tex. He was previously assistant district superintendent at Big Lake, Tex. **Ray E. Seifert** is the new assistant district superintendent at Midland.

Lawrence O'Donnell has been promoted to regional chief mechanical engineer of Shell Oil Co., Inc. in

L. O'DONNELL

W. S. CRAKE

Houston. The regional staff coordinates activities and acts in advisory and consultant capacities for the areas east of the Rockies. **W. S. Crake** has been promoted to chief mechanical engineer for the Houston area. Other area officers are located in Midland, New Orleans, and Tulsa.

James M. Cunningham has been appointed acting state geologist in Louisiana. A member of the staff of the Louisiana Geological Survey, Cunningham succeeds **Paul Montgomery,** who recently was appointed executive director of natural-gas conservation for the state.

P. L. Kartzke, senior exploitation engineer at Los Angeles for Shell Oil Co., Inc., is being promoted to manager of the San Joaquin division at Bakersfield.

F. C. Buckwalter, Shell Oil Co., was elected chairman of the Kansas Society of Petroleum Engineers at its December meeting last week in Elinwood. **R. G. Daley,** also with Shell, was elected secretary-treasurer. They succeed **H. E. Allen,** chairman, and **P. R. Waddle,** secretary - treasurer, both with Carter Oil Co.

Robert Matteson, analytical-division supervisor of the Richmond Laboratories of California Research Corp., has been elected chairman of the California Section of the American Chemical Society for 1947. He succeeds **Dr. Louis B. Howard,** of the Department of Agriculture. Other new officers are **G. K. Rollefsonk** of the University of California chemistry department, vice chairman; **George M. Cook,** of California Research Corp., secretary; and **Fred D. Tuemmler,** of Shell Development Co., treasurer.

Dr. E. E. Rosaire, geophysicist, has been elected president of the San Jacinto chapter of the Texas Society of Professional Engineers to succeed **Dr. L. W. Blair,** Humble Oil & Refining Co. research consultant. Other new officers are: **W. B. Rawson,** vice president of Maintenance Engineering Corp., first vice president; **L. J. Neuman,** head of L. J. Neuman Co., second vice president; and **Noah Hull,** chief engineer for Hughes Tool Co., secretary. **Olin G. Bell,** of Humble Oil & Refining Co., **W. S. Scarborough,** of Reed Roller Bit Co., and **John H. Bringhurst,** of American Petroleum Co., were elected directors.

Gayle Griffin, scout for Superior Oil Co. of California, has been elected president of the Mississippi Oil Scouts Association succeeding **Le Roy Francis** of Carter Oil Co. Other new officers are: **Harry Edgeworth,** Southern Natural Gas Co., vice president; **R. B. Morton,** Barnsdall Oil Co., secretary; **Raymond Shively,** Sun Ray Oil Co., treasurer. Named as Mississippi editors of the national yearbook, "Oil and Gas Development in the United States," are **Virgil W. Michael,** of Amerada Petroleum Co., and **John McWilliams,** of Union Producing Co.

R. C. McCurdy, division manager in the San Joaquin Basin for Shell Oil Co., Inc., is being transferred to Maracaibo, Venezuela, where he will become manager for Shell operations.

Marion M. Vick, United Gas Corp. employe 17 years, has been promoted from senior accounting clerk to department chief clerk in the Houston division engineering department.

E. W. Masters, who has been on special assignment in New York, is being transferred back to Los Angeles and will resume his duties as manager of production for Shell Oil Co., Inc., in the Pacific Coast territory.

Robert W. Stuart, Stanolind Oil & Gas Co., has been transferred from the Tulsa office to the Fort Worth engineering department as senior mud engineer. **James C. Farris,** Stanolind junior engineer, was transferred from the company's Brownfield area to the Panhandle district. Farris was recently discharged from the service.

Twelve employes of The Texas Co. production department who have completed more than 10 years of work without a lost-time accident were honored recently with a dinner in Bristow, Okla. Holding the safety records are **Jerry Conners,** production foreman; **Jess Austin, Ed Bell, George Dotson, John Easley, Charley Grimes, Ed Huston, Charles H. Kidd, Glover McClead, John Pennington, Henry W. Stephens, Dewey White,** and **Dave Anderson.**

Dewey A. Jordan, production superintendent, Atlantic Refining Co., was elected president of the Petroleum Engineers Club of Dallas last week. Other officers for the coming year are: **T. S. Bacon,** research engineer, Lone Star Gas Co., vice president in charge of programs; **H. J. Gruy,** petroleum engineer, DeGolyer & McNaughton, vice president in charge of entertainment and arrangements; **C. D. Deschner,** Continental Supply Co., vice president in charge of membership; and **R. U. Maddox,** Big West Drilling Co., reelected secretary-treasurer.

Ragnar Giske has been appointed manager of marine sales for the Washington division, General Petroleum Corp., at Seattle, succeeding Carl J. Waage, deceased.

W. C. Chonette, general manager in Alberta for Shell Oil Co., Inc., since it started operations in the province, will return shortly to Los Angeles to a new position with the company. He will be succeeded by **Melvin W. Sheppard.**

P. E. Lehr, San Joaquin division superintendent for Shell Oil Co., Inc., with headquarters at Bakersfield, is being promoted to general production superintendent at Los Angeles where he will have charge of all Pacific Coast operations.

Frank C. Fogarty has been named executive secretary of the Rocky Mountain Oil and Gas Association by the newly elected executive committee to succeed **H. O. English,** who resigned to accept the managership of the oil department of the Casper National Bank. Fogarty, former sales manager of Home Oil & Refining Co., Great Falls, Mont., until joining Petroleum Administration for War, was associated until recently with Gray Refinery, Inc., at Newcastle, Wyo.

W. E. Leroux, division engineer for Carter Oil Co.'s central division at Seminole, Okla., has been named assistant to the production manager for Carter with headquarters in Tulsa. He is being succeeded at Seminole by **J. L. Rogers,** district engineer in the Dix district of Illinois. Except for 3 years abroad with European Gas & Electric Co., Leroux has been with Carter since 1933. Rogers will be succeeded by **James Kelley,** engineer in the eastern division.

The Mississippi-Alabama division of the Mid-Continent Oil and Gas Association elected new officers at a recent meeting. They include E. D. Kenna, executive vice president; W. M. Vaughey, president; J. P. Evans, vice president, all of Jackson

Robert B. Moran, Los Angeles, international oil and mining geologist, addressed the Southern California Section of the A.I.M.E. at its final 1946 meeting December 10. His talk was based on observations in Peru, Mexico, and other Latin American countries. At one time Moran was head of Compania de Petroleo Ganso Azul which is developing the Agua Caliente concession in eastern Peru.

L. A. Farmer, president, Northern Oklahoma Gas Co., Ponca City, was elected first vice president of the Oklahoma Utilities Association at a meeting last week in Tulsa. **Malcolm Morrison,** Oklahoma Gas & Electric Co., Oklahoma City, was elected second vice president, and **E. C. Joullian,** president, Consolidated Gas Utilities Corp., Oklahoma City, was named treasurer. **W. R. Thomas,** Oklahoma manager, Southwest Natural Gas Co., was named a director for 3 years, and **J. Y. Wheeler,** Oklahoma manager, Lone Star Gas Co., and **W. L. Woodward,** president, Zenith Gas Systems, Inc., Alva, were named directors for 1 year. **S. I. McElhoes,** Public Service Co. of Oklahoma, was named president.

SHIFTS—

M. T. Miller, foreman, Standard Oil Co. of California, Taft, Calif., to Pasadena, Calif.; **O. P. Adington,** superintendent, L. O. McMillan, Henderson, Tex., to Whitesboro, Tex.; **H. L. Hoover,** foreman, The Texas Co., Jasper, Tex., to Cuero, Tex.; **John D. Stohn,** superintendent, Snowden Oil & Gas Co., Jefferson, Tex., to Shreveport; **Henry Bollig,** foreman, Ryan Consolidated Petroleum Corp., Electra, Tex., to Okmulgee, Okla.

Marjorie Fuqua, geologist, Humble Oil & Refining Co., Houston to Bellaire, Tex.; **W. W. Rand,** geologist, Shell Oil Co., Inc., Houston to Santa Barbara, Calif.; **L. H. Patrick,** foreman, Phillips Petroleum Co., Odessa to Notrees, Tex.; **R. L. Kretz,** geologist, The California Co., Ruston, La., to Denver.

J. Paul Ratliff, Jr., engineer, Humble Oil & Refining Co., Crowley, La., to New Orleans; **F. T. Holden,** geologist, Carter Oil Co., Shreveport to Jackson, Miss.; **F. M. Beal,** engineer, Carter Oil Co., Mattoon, Ill., to Independence, Kans.; **Ward L. Paine,** engineer, Standard Oil Co. of California, Nunda, N. Y., to Orlando, Fla.; **A. B. Kittner,** foreman, Elk Refining Co., Clendenin, W. Va., to Shiveley, Ky.

E. R. Woolfolk, geologist, Stanolind Oil and Gas Co., Durango, Colo., to Sweetwater, Tex.; **James N. Wilson,** geologist, Seismograph Service Corp., Chandler, Okla., to Duncan, Okla.; **R. Schoenthaler,** engineer, Phillips Petroleum Co., Bartlesville, Okla., to Oklahoma City; **Jack Villines,** engineer, Acid Engineering Co., Tulsa to Lakin, Kans.

Equipment Men in the News

Walne and Gretzler Elevated in National Supply Export

A. E. Walker, president of National Supply Co., has announced appointment of two new vice presidents of National Supply

T. J. WALNE

E. M. GRETZLER

Export Corp., a company subsidiary. Thomas J. Walne, who has been division engineer of the corporation, will be vice president and general manager, and E. M. Gretzler will be vice president in charge of export sales. The corporation has offices at 30 Rockefeller Plaza, New York.

Rockwell Manufacturing Acquires Ohmer Corp.

Purchase of Ohmer Corp., Dayton, by Rockwell Manufacturing Co., Pittsburgh, has been announced by Col. Willard F. Rockwell, board chairman and president. J. Allen Harlan, who has served as president of the Dayton concern for the past year, will remain with the new ownership as vice president. The company will continue to operate as Ohmer Corp., and maintain plant and headquarters in Dayton.

Metz Named Assistant District Manager

Carl C. Wimberly, Oklahoma district manager of Lucey Products Corp., with offices at 501 First National Bank Building, Oklahoma City, announces the appointment of Verl T. Metz as assistant district manager for Oklahoma. Metz headquarters at the Oklahoma City office. Delbert M. Hadden has been named store manager of the Oklahoma City branch store.

Gar Wood Names Hiller Southwest Manager

Russell D. Hiller, Jr., has been named district manager, general line, for Gar Wood Industries, Inc., with headquarters in Tulsa, it is announced by W. H. Hammond, vice president in charge of sales. Hiller's territory embraces Texas, Oklahoma, and Louisiana.

Franz Elected Vice President Of Colorado Fuel & Iron

Carl W. Meyers, president of Colorado Fuel & Iron Corp., announces election of A. F. Franz, Pueblo, Colo., as vice president in charge of operations. He succeeds Robert T. Dunlap.

Thornton Tandem Changes Name

Thornton Tandem Co. has discontinued that name and now is operating as Detroit Automotive Products Corp. Announcement of the new company name came from F. D. Knoblock, president. He added there has been no change in management, personnel, or corporate structure. Other officers and executives are A. F. Knoblock, chairman of the board; S. F. Baker, vice president; R. F. Barnum, secretary-treasurer, and Ivan Graham, sales manager.

Cameron Iron Transfers Buchanan and Davis

Cameron Iron Works. Houston, announces the appointment of Roy Davis as manager of sales for the West Texas district. He will be assisted by A. A. O'Conner, who was recently transferred from Natchez, Miss., to Odessa, Tex., and M. L. Hooks, who will operate from Hobbs, N. M. R. C. Buchanan, formerly of the Houston sales department, has been appointed salesman for the Rocky Mountain district with headquarters at 356 North Wolcott Street, Casper, Wyo.

Green Fire Brick Forms Service Division

A. P. Green Fire Brick Co. announces the formation of a new division, A. P. Green Engineering & Management Co., which offers engineering and management service to refractory and allied clay plants throughout the world.

McKnab Rocky Mountain Representative for Cardwell

John W. McKnab, recently appointed as Rocky Mountain representative for Cardwell Manufacturing Co., Inc., Wichita, announces establishment of his permanent headquarters in Casper, Wyo. McKnab's territory includes Wyoming, Montana, and Colorado.

Borden and Asquith Sales Managers for Kaiser

Kaiser Co., Inc., Iron and Steel Division, announces the appointments of C. F. Borden as assistant general sales manager and R. L. Asquith as products sales manager, tubular and specialty products. Jack L. Ashby, general sales manager, stated Borden will continue as Oakland district sales manager in addition to his new responsibilities. Both Borden and Asquith will headquarter in the Oakland office.

Barium Steel Acquires Bayonne Bolt

Barium Steel Corp. announces acquisition of full control of Bayonne Bolt Corp., Bayonne, N. J., producer of bolts, nuts, rivets, and similar steel products.

Project Engineering Expands Office

Project Engineering Co. has moved its general offices to new quarters at 115 Fulton Street, New York. Work on four oil-refinery units is now in progress at the new offices. Present offices at 15 Maiden Lane will be maintained. The company is operating under James P. O'Donnell, manager, and Guy M. Barbolini, chief engineer. The fabrication shop at Long Island City, N. Y., is also operated by the company under the management of Barbolini.

Tracy Elected Vice President Of Oil Well Supply

Fred F. Murray, president of Oil Well Supply Co., U. S. Steel subsidiary, recently announced the election of Lloyd E. Tracy as vice president of the company. Tracy retains the position of general manager of sales.

LLOYD E. TRACY

New Sales Engineers Appointed by Lincoln Electric

Lincoln Electric Co., Cleveland, announces the appointment of the following new welding sales engineers: Marvin Anderson, appointed to the Moline, Ill., office; Albert Bavaria, appointed to the Philadelphia office; Richard Freundlich, appointed to the Cleveland sales office; Paul Holden, appointed to the Franklin, Pa., sales office; Richard Nelson and John E. Williams appointed to the Syracuse office, and Richard K. Reynolds, appointed to the Detroit office.

Costello Associates With Zurn Manufacturing

William C. Costello resigned as special assistant to the board of directors, Reconstruction Finance Corp., vice president and director of the RFC Mortgage Co., and a director of the Federal National Mortgage Association, both subsidiaries of RFC, to become associated with J. A. Zurn Manufacturing Co., Erie, Pa. He will open offices for the company in Washington and Houston.

Dravo Opens New Office in Atlanta

Dravo Corp., Pittsburgh, has opened a new sales office at 305 Techwood Drive, N. W., Atlanta. Robert A. Hedges has been transferred to manage the office. He will handle sales, through local distributors in Alabama, Georgia, Florida, Louisiana, Mississippi, North and South Carolina, Tennessee, and parts of Arkansas and Virginia.

Holden in Far East for Stanco

C. E. Holden, export department of Stanco Industries, Inc., is on a 6-month trip to the Far East to observe operations of Stanco agencies and distributors. He will visit the Philippines, China, Netherlands East Indies, the Straits Settlements, and Thailand. Holden was the company's eastern representative until the outbreak of the war.

Parsons Named by American Brake

American Brake Shoe Co. announces the appointment of Homer Parsons as assistant director of exports. Parsons has been a sales representative for the company's export department since August 1945. Stuart F Brown, director of exports, is on an extended trip throughout South America, Panama, and Cuba. He is scheduled to return during March. The company's resident regional managers in Latin America, J. F. Vallet and W. J. Mohr, will travel with Brown.

Sievers Moves Offices

W. E. Sievers announces the moving of his offices in Whittier, Calif., to the Quimby Building, 650 South Grand Avenue, Los Angeles. Sievers recently resigned as chairman of the board of Security Engineering Co., Inc., to devote his entire time to Sievers Industries, Inc.

Badger & Sons Establishes Foreign Concerns

E. B. Badger & Sons Co., with offices in Boston, New York, and San Francisco, announces the following additions to its facilities serving the petroleum, petrochemical and chemical industries. E. B. Badger & Sons (Great Britain), Ltd., has been re-established with offices at 2 Great Winchester Street, London. J. T. T. Robinson is director and general manager. A Brazilian company, Badger Servicos Tecnicos de Engenharia, S.A., will open offices about the first of the year at Rua Buenos Aires 135, Rio de Janeiro, Brazil. The officers of this company include Dr. Roger H. Newton, director-president; Ernest V. Owen, director-technical; and Dr. Eduardo Guinle Filho, director-financial. Fluor-Lewis & Co., comprised of J. S. Fluor and Milton Lewis, has been appointed its Western United States representative with offices at 416 Petroleum Building, Los Angeles.

Texasteel Plant Electrically Equipped

A. J. Armstrong, executive assistant, announces Texasteel Manufacturing Co., Fort Worth, has not been affected by the coal strike as its steel is made in electric furnaces. As a result the company offers immediate delivery on electric steel sucker rods.

Moulton and Buist Named Turco Sales Chiefs

Appointment of L. H. Moulton to the post of national sales director, and D. T. Buist, assistant national sales director, was announced recently by Ray Sanders, vice president and general manager, Turco Products, Inc. Their headquarters will be the firm's main offices in Los Angeles.

Bechtle Eastern Representative Of Texas Electric Steel

J. F. Bechtle has been named eastern sales representative for Texas Electric Steel Casting Co., Houston. Bechtle will maintain offices at 7 East Forty-second Street, New York, Tom W. Shartle, president, has announced.

Billings New District Manager of Falk

L. H. Billings has been appointed district manager of a newly created Falk Corp. sales territory, it was announced recently

L. H. BILLINGS

B. C. BUGBEE

by Walter L. Schneider, vice president and director of sales. Formerly production manager, Billings directs sales in Wisconsin, upper Michigan and parts of Iowa. Harold F. Falk, works manager, announced that B. C. Bugbee, Jr., had been named production control manager.

Stacey Rejoins Carrier

Alfred E. Stacey, Jr., one of the seven founders of Carrier Corp., has rejoined the organization according to an announcement by Arthur P. Shanklin, vice president and general sales manager. Stacey, who has been on active duty in the U. S. Navy with the rank of captain, will be process consultant to the sales division.

Blackmer Expands Engineering Department

An expansion program in the engineering department of Blackmer Pump Co., Grand Rapids, has been announced by B. L. Gordon, president. John B. Caldwell has been named chief engineer, and L. R. DeWolf and V. A. Brunson have been appointed senior engineers.

Gratz Rejoins American Manufacturing

Benjamin Gratz, Jr., has rejoined the staff of American Manufacturing Co., Brooklyn, cordage mill. Gratz, formerly Ohio representative, has been advanced to southern sales representative and covers the states of Florida, Alabama, Georgia, and South Carolina.

Mullen Sales Manager for Globe Steel Tubes

LEE MULLEN

Frank J. O'Brien, vice president in charge of sales, Globe Steel Tubes Co., announces the appointment of Lee Mullen as general manager of sales with office at Milwaukee. Mullen has been with the company since 1943, and was formerly with Sharon Steel Co., Republic Steel Corp., and Pittsburgh Steel Co.

Jacobs Elevated by Gilbert & Barker

Irving C. Jacobs, director and export manager of Gilbert & Barker Manufacturing Co., has been appointed assistant to President Stanley C. Hope, in addition to his other duties.

Brown Instrument in New Tulsa Site

Brown Instrument division of Minneapolis-Honeywell Regulator Co. has opened a new branch office at 117 West Eighth Street, Tulsa, in charge of R. P. Walker, branch manager.

Curtis Pacific Coast Manager of Babcock & Wilcox

Harold P. Curtis is the new Pacific Coast sales manager, Babcock & Wilcox Tube Co. announced recently at the main office, Beaver Falls, Pa. Curtis' headquarters are in the Banks-Huntley Building, 634 South Spring Street, Los Angeles.

McCoy in South America For Foster Wheeler

C. D. McCoy, Foster Wheeler Corp.'s manager of export sales, is on an extended business trip to South America.

Rankin Joins Du Pont

Stewart L. Rankin, M.D., joined the staff of the petroleum chemicals division of E. I. Du Pont de Nemours Co.'s organic chemicals department on November 1. He will direct special studies of that division.

Riddle and Hubbell Manufacturers Representatives

Ray F. Riddle and L. W. Hubbell have recently established a manufacturers representative firm in Tulsa representing electri-

RAY F. RIDDLE

L. W. HUBBELL

cal and mechanical driver equipment. Both are electrical engineers and natives of Oklahoma; Riddle graduated from Oklahoma A. & M. College and Hubbell from Oklahoma University. Offices are located at 209 Midco Building.

Republic Supply Opens New Store at Abilene

Republic Supply Co. announces the official opening of its newest supply store at 1641 Pine Street, Abilene, Tex. E. E. Copeland, who has represented the company in the Fort Worth and Shreveport areas for many years, will be the new Abilene store manager.

Farrel-Birmingham Reopens Chicago Office

Farrel-Birmingham Co., Inc., Ansonia, Conn., and Buffalo, has reopened its branch office in Chicago, locating at 120 South LaSalle Street. The office is in charge of Harry Temporal, who has been connected with the company for 26 years.

Hogarth Named Pennsalt Purchase Engineer

Barton I. Hogarth has been named purchase engineer in the equipment and supplies division of Pennsylvania Salt Manufacturing Co. purchasing department, N. W. James, general purchasing agent, announces.

Wagner Division Manager Of Jarecki Manufacturing

Karl G. Wagner has been appointed manager of the Oklahoma-Kansas Division of Jarecki Manufacturing Co. with division headquarters at Tulsa.

Sheehan Manager of Hyster Plant

Appointment of Dan J. Sheehan as manager of the Danville, Ill., plant of the Hyster Co. has been announced by Frank L. Ross, eastern division manager.

Alcoa Makes Change

After January 1, 1947, the alumina and fluoride products of Aluminum Ore Co., an Alcoa subsidiary, will be marketed under the Alcoa trademark and trade name, and all merchandising will be conducted in the name of Aluminum Co. of America, Chemicals Division. Aluminum Ore Co. will continue the actual manufacture of these products.

Schlumberger Transfers Burge

E. J. Burge has arrived in Lloydminster, Alta., from Trinidad as assistant to C. W. Bailey, chief engineer for Schlumberger Well Surveying Corp. at that point.

A.C.S. Digests

(Continued from page 40)

The gamma ray absorption coefficient varies from one substance to another. The three methods of gamma ray absorption by matter are the Compton effect, the photoelectric effect, and pair formation. (A detailed discussion is presented).

Radium is hermetically sealed in a small silver capsule to give a constant gamma-ray source. The old curie is 1 gram of radium in equilibrium with radon. The new curie is 3.7 x 10 disintegrations per second.

Lead absorbs gamma rays by the pair formation method and in turn gives off secondary rays. For this reason a thin sheet of lead will serve as an intensifying screen.

In taking a radiograph four variables must be considered: (1) Radium source in curies, (2) radium to film in inches, (3) type of film used, (4) thickness of material. For instance, 200 mg. of radium, at a radium to film distance of 10 in., using Eastman type "K" film with 1 in. of carbon steel, would take 6 minutes.

Effect of Altitude on C_4 and C_5 Blending Calculations

N. B. HASKELL and J. A. REDINGER, The Texas Co., Port Arthur.

EFFECT of atmospheric pressure, or altitude, on calculations of the front end volatility of gasoline blends is associated with the response of gasoline fractions of varying composition to the A.S.T.M. distillation procedure, and the subsequent conversion of the distillation data from the recovered to the evaporated basis.

An apparatus has been devised which permits A.S.T.M. distillation tests to be conducted at any point at the atmospheric pressure of other locations. Necessary modifications to improve reproducibility are described. A series of 16 blends containing from 0 to 30 per cent C_5 component and 0 to 15 per cent C_4 component were prepared and distilled at four pressures from 600 to 780 mm. mercury. From these data were developed the effect of atmospheric pressure and composition on distillation loss. The Sydney Young equation used for converting distillation data to other barometric pressures may be erroneous up to the 20 per cent point because most of the loss occurs after reaching the initial boiling point. Existing correlations for the calculation of front end volatility of C_4 and C_5 blends are revised to incorporate the effect of barometric pressure.

The History of Commercial Production of Butadiene by the Catalytic Dehydrogenation of Butylenes

W. L. HILLER, Jr., Cities Service Refining Corp.

THIS paper deals primarily with process developments related to the petroleum butadiene industry. Functions of the various units comprising a typical butadiene plant are given. However, the discussion is centered on the butylene dehydrogenation process beginning with the development of the cyclic steam dilution process by Standard Oil Development Co.

Among the basic design factors considered are the chemical nature of the reactant and product and the thermodynamics of the primary reaction of n-butylene and butadiene plus hydrogen.

The application of the steam dilution process using "Catalyst 1707" to commercial operation and some of the operating difficulties encountered are presented. Also discussed are the development and commercial application of continuous operating catalyst with the steam dilution process, setting forth the advantage of continuous over cyclic operation. Possibilities of future catalyst developments are outlined.

Investigation of a Girbotol Unit Charging Cracked Refinery Gases Containing Organic Acids

F. R. CLEGG and W. E. NORRIS.

EXCESSIVE diethanolamine consumption has been experienced at Pure Oil Co.'s gas purifying system (Girbotol unit) since its installation. This condition grew progressively worse as heavier hydrocarbons were charged to the system. Investigation indicated that organic acids, principally formic and acetic, were chemically deactivating the amine. It was also found that the recommended method for determination of the amine content by titration with sulfuric acid, using methyl red indicator, would not give accurate results in the presence of the organic acid salts of the amine.

All attempts at regeneration of the amine solution by adding caustic to the system failed due to formation of iron hydroxide which fouled up the equipment. Continuous and batch water washing of the feed gases was tried in actual plant operation to remove organic acids. This operation did remove the acids but resulted in a severe corrosive condition. It was found that the feed gases should be scrubbed with aqueous caustic solution before entering the gas-purifying system, as this would remove the organic acids and prevent deactivation of the amine.

Flow Properties of Asphalt Emulsions

C. V. LYTTLETON and R. N. TRAXLER, The Texas Co., Port Neches, Tex.

WORK with Brookfield viscometer shows a straight-line relationship obtained on a log-log plot of r.p.m. (rate of shear) vs. absolute viscosity of asphalt emulsions. All emulsions studied fell into one of the following groups: (1) Newtonian flow; (2) non-Newtonian flow; reduced consistency with increasing rate of shear, and (3) non-Newtonian flow; increased consistency with increasing rate of shear. Each type is illustrated graphically and data are given which confirm the low-tempreature susceptibility of asphalt emulsions.

Rheological characteristics of asphalt emulsions are principally dependent on: (1) Asphalt content; (2) particle size and size distribution, and (3) condition of the surface of the asphalt particles as determined by the nature of the water phase.

A short discussion is given of these variables and the necessity of considering all of them. Effect of centrifuging on particle size distribution and thus on consistency is illustrated, and effect of stabilizers and salts on the rheological properties of bituminous emulsions discussed.

Determination of Elemental Sulfur In Aromatic Hydrocarbons

R. E. LACOMBE, H. E. MORRIS, and W. H. LANE, Monsanto Chemical Co., Texas City, Tex.

UNRELIABILITY of the lamp method for the quantitative determination of elemental sulfur in hydrocarbons has been verified. For combined forms of sulfur, a study has been made in which certain variables of the method were investigated using a turbidimetric procedure for determination of SO_4 in the absorbing solution. The method was improved by substituting Pyrex glass-wool wicks for the usual cotton ones.

A rapid new volumetric method for determining elemental sulfur, in the range from 0.1 to 20 per cent in aromatic hydrocarbons dependent on the reaction, S plus Na_2SO_3 —$Na_2S_2O_3$, is described. Data are presented to demonstrate the accuracy of this method.

Rotation Speed in Continuous Rotary Filter Operation

E. J. REEVES, Magnolia Petroleum Co., Beaumont.

THE general equations for batch filtrations are used in development of a relationship betweeu filtrate volume and drum rotation speed in continuous rotary filter operations. The data give excellent agreement between calculated and observed capacity gains resulting from increased rotation speeds. Equations are developed for processing stocks which have low solid content. These relationships show that filter output is constant for a given cake thickness irrespective of the method used to maintain this thickness, i.e., recirculation of solids or reduction in rotation speed.

A Method for the Determination Of Optimum Conditions for Titrimetric Determinations

WILLIAM B. HUCKABAY and CLYDE J. NEWTON, Magnolia Petroleum Co., Dallas.

A NEED has been felt for a general method for the selection of end points of titrations. A method is particularly needed where incomplete chemical reactions are used for quantitative titrimetric determinations.

Optimum conditions are discussed for the general types of reactions occurring in the titrations studied. A graphical method is developed, based on relations derived from the definition of the stoichiometric point of reactions. The method described allows the selection of conditions where the end point of a titration may be chosen at the stoichiometric point of the reactions involved. Specific values of variables are determined under conditions where most dependable results are obtained. Accuracy of the determination of variables is limited only by the accuracy of the calibration of the equipment used in the study.

Long Beach Authorizes Deflected Drilling Plans

LOS ANGELES.—The Long Beach City Council last week authorized preparation of plans for drilling 25 deflected wells from the harbor pier to points in a 240-acre city owned tract beneath the ocean.

Before authorizing preliminary steps in further development of Zone 237 at Wilmington, the Long Beach council heard E. J. Amar, port manager, explain that the 240-acre seaward tract, extending from the pier and breakwater in the harbor, would accommodate completion of 75 deflected wells.

This is the first phase of a program under which Long Beach Oil Development Co. plans completion of possibly 200 additional wells in the prolific Zone 237, conducting operations from rigs spotted on existing piers.